THE

MINING AND SMELTING MAGAZINE:

A MONTHLY REVIEW OF

PRACTICAL MINING, QUARRYING, & METALLURGY,

AND

Record of the Mining and Metal Markets.

EDITED BY

HENRY CURWEN SALMON, F.G.S., F.C.S.

VOL. I.

JANUARY—JUNE,

1862.

London:
PUBLISHED AT THE OFFICE, 79, OLD BROAD STREET CITY, E.C.
AND SOLD BY
SIMPKIN, MARSHALL, AND CO., STATIONERS' HALL COURT,
J. B. BAILLIERE, RUE HAUTEFEUILLE, PARIS;
BAILLY BAILLIERE, CALLE DEL PRINCIPE, MADRID;
BAILLIERE BROTHERS, 440, BROADWAY, NEW YORK; B. DAWSON & SONS, MONTREAL;
T. T. BAILLIERE, COLLINS STREET EAST, MELBOURNE.

PRINTED BY HARRISON AND SONS, ST. MARTIN'S LANE, W.C.

PREFACE.

In concluding the First Volume of the "Mining and Smelting Magazine," the Editor is conscious of many shortcomings. To a great extent these were unavoidable in the commencement of a periodical of this description, and only to be overcome by experience. He hopes henceforth to make the Magazine in every way worthy of the kind aid and liberal patronage he has received from almost all connected with mining and metallurgy, whose aid and patronage are most valuable.

London, *June*, 1862.

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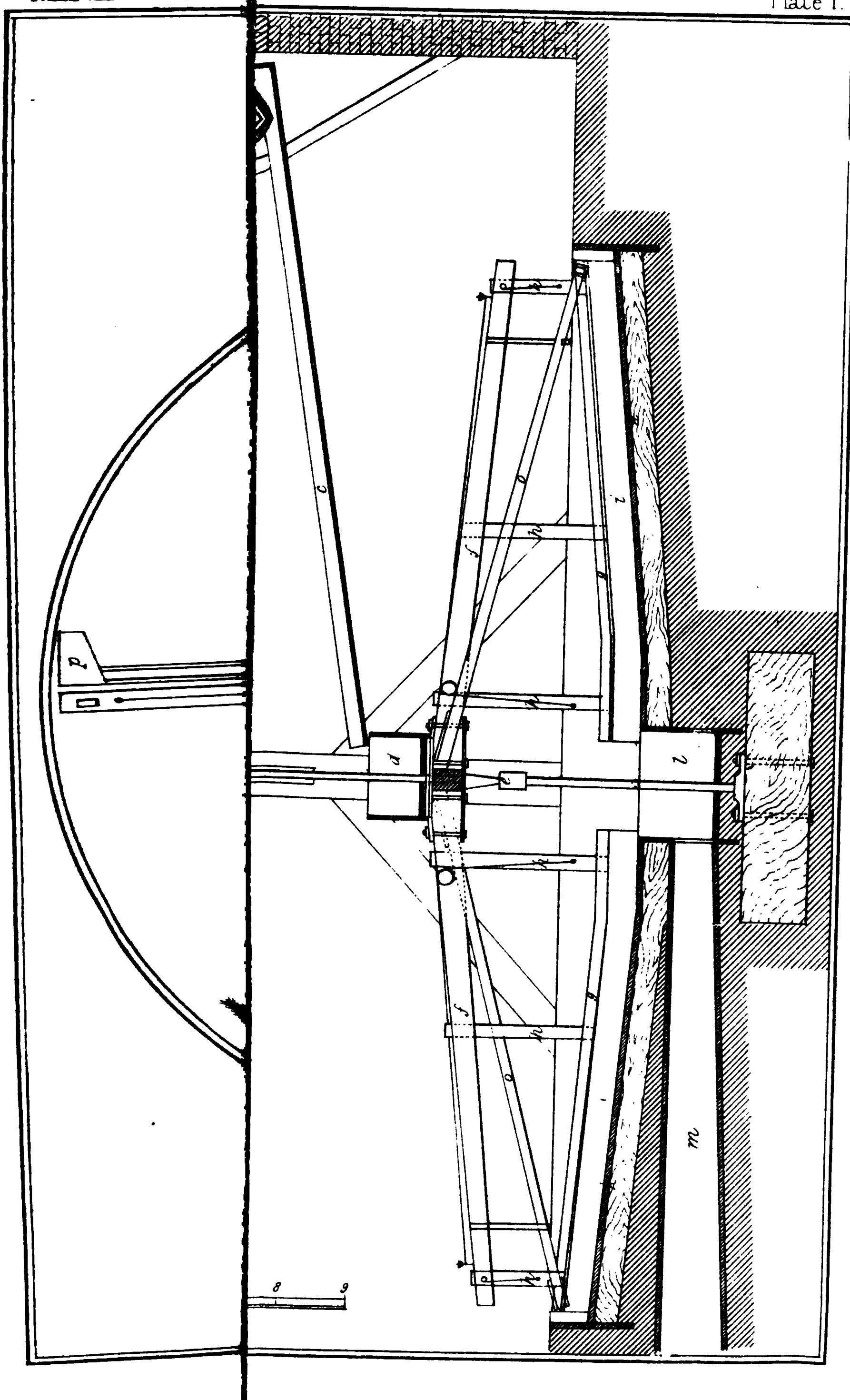

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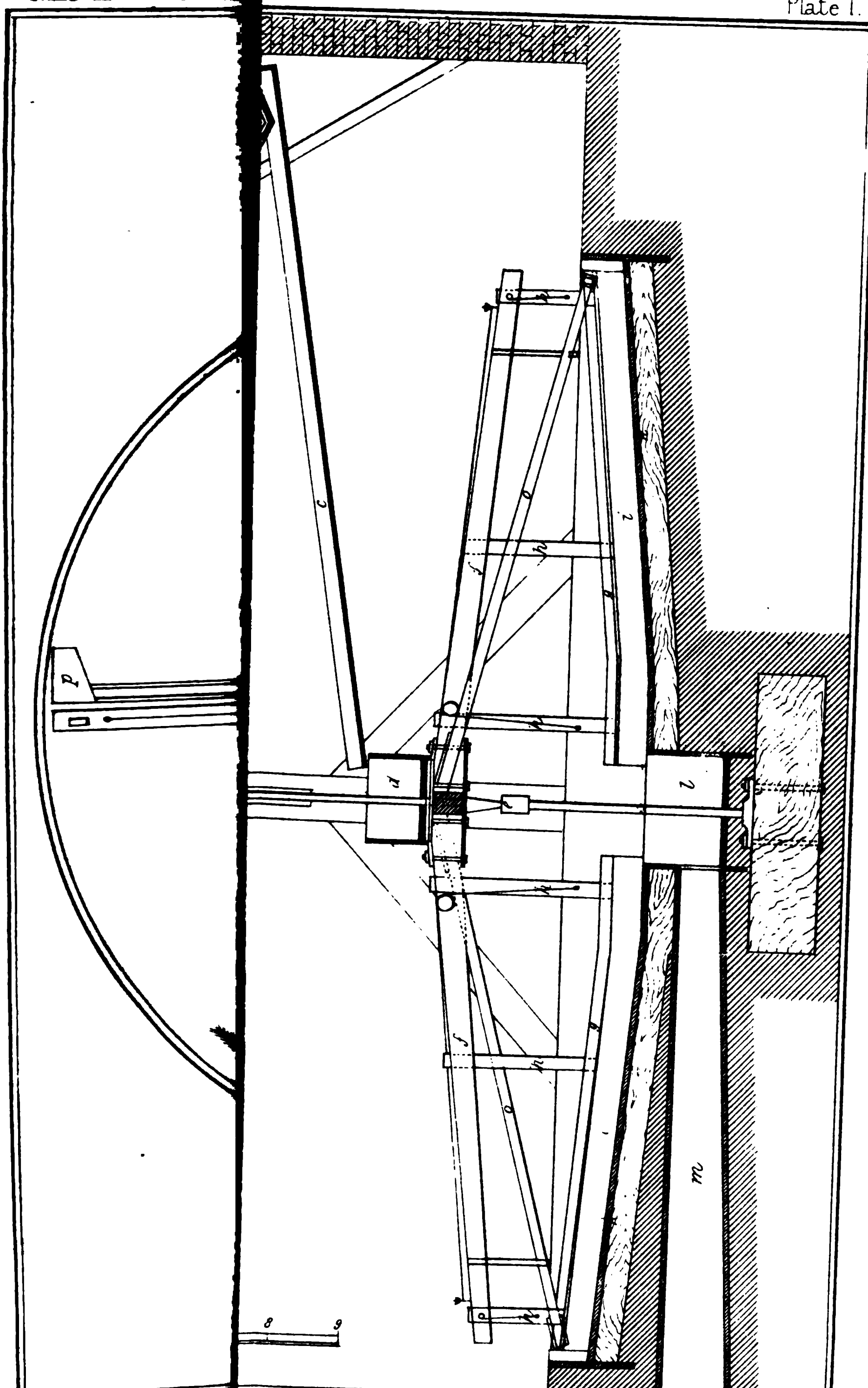

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THE

MINING AND SMELTING MAGAZINE.

JANUARY, 1862.

The History and Present Position of the British Coal Trade.

By EDWARD HULL, B.A., F.G.S.,

Of the Geological Survey of Great Britain: Author of "The Coal Fields of Great Britain."

WE shall here present our readers with a short sketch of the rise and progress of the production of coal—as introductory to a series of special articles on each of our great coal fields, which we hope to furnish from time to time.

The subject, it must be allowed, is one of deep interest and importance, whether we consider the number of persons at present employed directly and remotely in raising and transporting the mineral, the amount of capital invested in collieries, and the universal application of coal to domestic and manufacturing purposes, as well as for smelting ores and propelling machinery. Indeed, so varied are the uses of coal, that, deprived of its aid, we can scarcely conceive any other result than that art, science, manufactures, and society itself would be brought to a dead stand. We may, it is true, believe that other forces of nature would, in such a case, be called into action, where now they are dormant; that heat might be evolved from air, water, and other sources. However, we have to deal with our social economy as it now exists; and seeing how largely it is dependent upon the supply of mineral fuel, it becomes of importance to discover to what extent we may look forward to its supply for future years. A well-founded knowledge of the resources of our coal fields will tend to prevent a repetition, on the one hand of such panics, and, on the other, possibly over confident assurances, to which the nation has lately been a witness. It certainly becomes the statesmen of a great nation to investigate to what extent they may count upon the supply of a mineral essential to our commercial greatness and political ascendency, yet in itself of limited distribution, and which when once consumed is for ever lost. With these preliminary remarks we proceed to the subject more immediately before us.

If we are to place reliance on the evidence of stone-headed implements found in excavations in South Wales, Leicestershire, and elsewhere, it would seem that coal-mining had its commencement in very early pre-historic times. The existence of cinder heaps in the north of England in and about Roman stations, leads us to suppose that the Roman conquerors of Britain were not unacquainted with the uses of coal as a fuel, though we have no documentary evidence of the fact. In addition, however, to the positive evidence here referred to, it seems improbable that the natural out-cropping of beds of coal on the banks of rivers and hill sides should have failed to attract the notice—and stimulate the curiosity—of a people so generally observant and enterprising.

The first historical notice of the use of coal for domestic purposes is the solitary one in the Saxon Chronicle (A.D. 852), in which the mineral is referred to under the term "græfan." Whether this is the earliest term applied to coal, or whether the Celtic name "glo" is of earlier date, must remain a matter for conjecture; yet there is every probability that the mineral was extracted from its bed amongst the hills of South and North Wales at a period quite as far back as that of the Anglo-Saxon kings.

Before we again meet with reference to this subject we have to pass over several centuries to the reign of Henry II. At this time are recorded the two well-known passages in the Boldon Book, in the year 1183. In the year 1259 we find the first public recognition of coal as an article of commerce, and from the charter of Henry III. to the freemen of Newcastle-on-Tyne we may date the foundation of our coal-trade. From this time, Newcastle began to pour into the London market an ever-increasing supply from the great northern coal-field; which, in the year 1860, reached the large amount of 1,347,574 tons. In succeeding years we find frequent references to coal-produce;* and it is probable that during the 14th and 15th centuries mining became general in most, if not all, of the coal-fields of Britain. In the reign of Queen Elizabeth the trade flourished; but it received a check from monopolies and taxation during the time of Charles I., until relieved by the interference of Parliament.

We are indebted to Campbell for the first statistical accounts of the quantity of coal raised in Britain. The quantity raised in 1670 was 200,000 chaldrons, which sold at seventeen shillings† a chaldron; in 1690 upwards of 300,000 chaldrons, and in 1760, 600,000 chaldrons were annually consumed. The production constantly increased till, at the commencement of the present century, it reached about ten millions of tons. In 1819 the production has been estimated by Mr. R. C. Taylor to have reached 13 millions. In 1840, the quantity raised, as estimated by Mr. M'Culloch, was 40 millions. Passing on to the year 1854, in which the first volume of the *Mineral Statistics of Great Britain* was issued by Mr. R. Hunt, and in which we have,

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* See, Matthew Paris's *History*, 1245; Leland's *Itinerary*, vol. viii.; Surtee's *History of Durham*, vol. iii. p. 396; Ænei Sylvii *Opera*. p. 443, where mention is made of mining in Scotland in the 14th century; Pennant's *Tour in Wales*, vol. i.

† This sum in our time would be equal to at least 30 shillings current.

therefore, the first authoritative information on the subject, we find the production for Great Britain and Ireland, in that year*, set down at 64,661,401. Henceforth, the yearly issue of the Mineral Statistics puts us in possession of reliable information, collected under the auspices of government, on the produce of Great Britain and Ireland; and the following summary for each year up to 1860 shows that this great branch of British industry has been undergoing a steady, though variable, expansion.

Coal raised in Great Britain and Ireland from 1854 *to* 1860.

		Tons.
1854	England and Wales	57,064,651
	Scotland	7,448,000
	Ireland	148,750
	Total	64,661,401
1855	England and Wales	56,983,450
	Scotland	7,325,000
	Ireland	144,620
	Total	64,453,070
1856	England and Wales	59,008,815
	Scotland	7,500,000
	Ireland	136,635
	Total	66,645,450
1857	England and Wales	57,062,604
	Scotland	8,211,472
	Ireland	102,630
	Total	65,376,706
1858	England and Wales	55,961,650
	Scotland	8,926,249
	Ireland	120,750
	Total	65,008,649
1859	England and Wales	61,559,465
	Scotland	10,300,000
	Ireland	120,300
	Total	71,979,765

* The produce of Ireland for this year is so small as compared with Great Britain (148,750 tons) that the total amount would not be materially altered by subtracting it.

1860	England and Wales	69,022,773
	Scotland	10,900,500
	Ireland	119,425
	Total	80,042,698

To the above ought to be added, on account of waste on fire-heaps, at least 4,000,000 tons; making a grand total of 84 millions of tons during the past year. In the same period the number of collieries in the United Kingdom has increased from 2,397 in 1854 to 3,009 in 1860. This great drain upon our coal-fields has, in all probability, by no means approached its maximum. With a constantly increasing population, the expansion of the iron trade, and of manufacturing industry; the gradual substitution of steam vessels for sailing ships, in our navy and mercantile marine, and the increase in our export trade, we may look forward to a much larger production than has been yet attained. It is not improbable that the present generation may witness that amount reaching one hundred millions of tons annually.

Such an event will not be considered impossible by those well acquainted with the structure and capabilities of our coal-fields. While in a few limited districts,—such as those of Flintshire, Coalbrook Dale, South Staffordshire, and others,—the coal is being rapidly exhausted, the majority of the coal-fields are by no means as yet fully developed. This is especially the case with regard to the South Wales, Denbighshire, North Staffordshire, and Yorkshire coal-fields, which are capable, without any extraordinary drain, of yielding from 10 to 20 per cent. over their present production. We shall not, however, now pursue this subject further, as we may have occasion to return to it at some future time.

Chapters on the Methods of Working and Ventilating Coal Mines.

By Mark Fryar, F.G.S.,
School of Mines, Andersonian University, Glasgow.

CHAPTER I.

The various methods pursued in working and ventilating coal mines have often been discussed, upon the reading of papers at meetings of mining engineers. A few books have likewise been written on the subject; and communications to public journals have also occasionally described local peculiarities in the operation of coal "getting," and, more frequently, have entered upon the merits or demerits of plans of ventilation, and the various means of producing ventilating currents. But hitherto no attempt has been made in the English language, to

bring into a consecutive form all that may be said on these important departments of mining, as they stand related to each other, and in their bearing separately upon the economy and safety of all coal mining works.

There must always—even in the earliest times—have been some general plan of work decided upon, and carried out, in conducting mining operations, whether derived from one or more directing minds, or being merely the result of rude deliberations and discussions—or even the unconscious experience—of workmen themselves. The primary object of these plans would necessarily be the economy of work, and the safety of the labourer,—however rude might have been the design, or however recklessly it may have been carried into effect. Still one can easily imagine, that considerable confusion and uncertainty of method would characterise the first attempts at coal mining, and that a tolerably well defined system of work could only arise out of considerable experience in the art, and after it had become necessary to sink shafts to the depth of many fathoms.

There is indeed one great difference between the motives influencing the primitive and modern miner in the economy of coal getting. A century or two ago, the total annual production of the country scarcely equalled the out-put of half a dozen of our largest collieries at the present day. With such a limited production, compared with seemingly boundless resources, it is not surprising, or indeed very blameable, if the miners of those days conducted their operations in the most wasteful manner, caring not how much of the coal—seemingly so inexhaustible—was lost, provided the portion saved was got at a low rate. The present total annual produce of British coal mines equals a seam of coal one yard in thickness and thirty square miles in area; and the advanced state of geological science has approximately made known to us the probable area of country in which coal exists at a workable depth. The limits of this area are certainly found to be wider than was formerly supposed, and to extend beyond those measures in which coal seams have already been proved by actual workings. Still the resources, great as they undoubtedly are, are *limited*—particularly within moderate depths;—and therefore, while the modern miner knows that a *small coal field* is being consumed every year, he is also aware that the quantity of coal still available, although enormous, has yet a limit, which he knows with a tolerable degree of accuracy. The primitive miner, in his ignorance, might have been fairly contented with a *portion* of the coal of each pit; the modern miner, with his present knowledge, should not, in justice to futurity, be content with less than the *whole of the coal* from each pit, apart from, and irrespective of, any immediate benefit arising from increased production.

Coal-mining is now rapidly increasing in difficulty and danger, owing to the greater depth at which coals are being worked, and, as a consequence, the greater extent to which explorations are being proceeded with from one or two shafts. The attention to economy and safety, which has always been required in mining operations in a special degree, ought therefore, at the present time, to be more than redoubled. Every means, consequently, of accurately determining, and widely disseminating, a correct knowledge of the expe-

rience of the past, and of the practically useful and profitable innovations of the present, should be made as available as possible to all mine-managers, captains, and overmen, and to every workman who has the ambition to raise himself into a higher position in connection with his calling. The mining engineer, of whatever grade he may be, is required to be steady, intelligent, and ingenious ; full of energy and perseverance ; cautious about novelties, and yet without prejudice against any thing simply because it is new.

To enter upon a minute description of the geology of the "coal measures" would be simply delaying the information which these chapters are intended to convey, and I must therefore assume that the reader has already made himself familiar with the prominent features of this preliminary portion of the study of coal-mining. I may, however, just remind him of the geological position in which coal is generally found. The principal beds or seams occur, in this country, in what is called the *carboniferous system ;* this being a name given to a series of rock strata, owing to a large number of coal seams being found associated with them. The *coal measures* are alternations of coal-beds, bands of iron-stone, layers of clay-shale, siliceous gritty rocks, and of sand-stone ; and in some places, as in the Scotch coal field, of beds of limestone. These form the upper portion or "formation" of the carboniferous system ; the millstone grit and carboniferous limestone forming the two other formations of the system in a descending order. In Scotland this geological system divides itself into—upper coal measures ; carboniferous limestone ; and lower coal measures : the representative of the millstone grit not being certainly known, and the carboniferous limestone being to some extent interstratified with the coal measures.

The thickness of seams of coal is very variable, ranging from a few inches up to nearly 100 feet. The inclination is also equally variable in its amount, the beds being sometimes nearly flat, and at other times almost vertical : between these two extremes well nigh every angle of inclination is to be met with. Coal is consequently worked at all depths : in some places it may be commenced with at the surface ; and at others, pits have to be sunk for it to a depth of upwards of 600 yards (more than one-third of a mile.) It is therefore evident, from the varying inclination of coal-seams, and the different depths at which they are wrought, that the methods pursued in working them must similarly differ from each other. Besides these main circumstances of dip or depth, there are several other local conditions which require to be very carefully considered, in deciding what system of working may be most economically and safely adopted. These I shall refer to in the following order :—

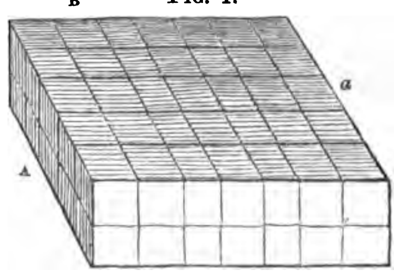
I. *The texture of the coal to be worked.*
II. *The character of the rock forming the roof and floor of the coal seam.*
III. *The relative positions of two or more seams to each other.*
IV. *Surface conditions from under which the coal is to be worked.*

I. THE TEXTURE OF THE COAL TO BE WORKED.—It will be seen from what has already been said, that, in working out coal seams situated at considerable depths from the surface, and inclining but at

a small angle from the horizon, the weight of the overlying strata is the chief matter to be dealt with. If the whole of the overlying mass of rock can be removed, and the coal wrought by opencast, the working becomes exceedingly simple, being nothing more than quarrying out the coals. The difficulties associated with coal working are principally owing to the enormous weight of rock overlying it. The weight of this mass may, certainly, in some cases of hard, tough coal, be made to do a large amount of the work of hewing or excavating; but where the coal is very soft and friable, if the weight is brought on over a large area, and upon long working faces, the result will most likely be in a measure injurious, as it will crush the coal and produce a large per centage of small—which is either valueless, or worth much less in the market than it would otherwise have been.

In most coals there are distinct and systematic joint-lines running parallel to each other at various distances apart. Of these there are two sets, one of which intersects the other, either at right angles or at angles moderately oblique. In addition to these joints there are also cleavage planes, varying in distinctness, and in their cleavage properties, in different coals. This is shown by the Fig. 1, which is intended to represent a block of coal. A *a* are the "backs," and B *b* the "joints." The cleavage is indicated by the fine lines, and is parallel to the "backs." I am not aware that there occurs in any coal such a regularity of lines of fracture as is shown by the figure; but it sufficiently indicates what is meant, and is, moreover, not a *widely exaggerated* representation of the jointing and cleavage of some coals.

FIG. 1.



To these planes in the coal there are, in some degree, corresponding planes of fracture in shale roofs; or, at any rate, the leading joints in the roof are parallel to joints in the coal. The following are the names given to drivages, or working passages, in the coal which are excavated, either directly or approximately, at right angles to the cleavage planes: in the South of England they are called "Hatchings;' in the North, "Bords;" and in Scotland, "Plane-ways." The corresponding names to these, applied to the passages driven in the direction of these planes, are "Headings," "Headways," and "Endways." I may, therefore, speak generally about *three* directions in which passages or working faces may be driven, namely:—

1, At right angles to the planes of the coal;

2, In the direction of the planes; and

3, Obliquely to the planes or in any direction between 1 and 2.

I shall have to refer to these directions for drivages when speaking about the systems of working. I need not multiply words to show the importance of working coal so as to produce it in a good marketable condition; and with as little waste as possible. Very shameful, and highly culpable, waste of this valuable mineral has resulted from defective methods of working it; and this in many cases without any

advantage to either the proprietor or the lessee :—on the contrary, had the system of working pursued been such as to produce the largest possible amount of good marketable coal, the profits of the colliery would have been vastly increased.

The weight of the roof of coal seams cannot be accurately determined, or even estimated ; nor can it, under the best management, be nicely regulated in its effect upon the coal ; yet this weight, and its effect, does admit of some degree of estimation and regulation. A neglect of these points may cause a very soft friable coal to be half wasted, or crushed into a useless, small, unmarketable commodity ; or cause a very hard tough coal to cost very much more for excavating than it would have done by a method of working which took the weight of the roof into consideration. The laminated or schistose coal, is more likely to be much broken by an excess of pressure from the roof than the massive, rhombohedral or cubical variety ; but there is a soft, easily pulverised coal which will suffer a still greater deterioration from the crushing strain of the roof than any other kind. On account of these differences, great care should be exercised in selecting the method of working best suited to the respective properties of the coal to be wrought.

The structure of the seam or bed requires, therefore, to be well considered before deciding upon the adoption of any system of working. And this has always been a matter of anxious attention among practical coal-miners : studying the "backs" is an old expression, well understood by some of the most experienced colliers; and "*the way she works best,*" or the comparative advantages of working "Bordways," "Headways," or "Crosscut," is a subject of frequent discussion among the pitmen of the Newcastle-upon-Tyne districts. A thorough knowledge of this subject is of immense practical importance to the hewer, and its careful study is of the greatest moment in carrying out, with the best economy, the operations of coal mining. "On the plane," "on the End" and "half plane" are corresponding expresssions well understood by the pit-men North of the Tweed ; and "Hatching," "Heading" and half "Hatching," are terms of similar import used by the miners of South Wales and Bristol. A consideration of the probable geological causes under which joints and planes of fracture have originated, would lead one to anticipate what is found to be actually the case : that is, that the condition of these structures would vary greatly within narrow limits. This in practice is found to be so, for in some instances, even in the same seam of coal and in the same pit, one part is found to work much better by driving the principal working faces across the plane of the coal; while in another part, the advantage is gained by carrying these faces in the direction of the plane. The colliery manager should therefore be constantly on the alert for any appearance of change in the structure of the seam, and adapt the position of the line of working to suit the run of the principal joints.

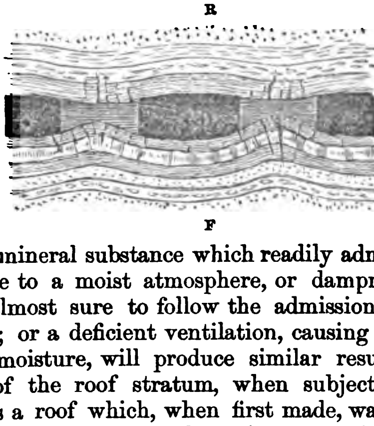
II. THE CHARACTER OF THE ROCK FORMING THE ROOF AND FLOOR OF THE COAL SEAM.—Since the management of the superincumbent strata forms the chief difficulty in the working of seams of coal, it almost necessarily follows that any difference in the composition, structure (or of the character in any way) of these strata, especially

such as lie immediately upon the coal, will either lessen or increase this difficulty; and that the adoption of certain special methods of working must be in intimate relation with the character of these strata. If the roof consists of any broken shale, or of several feet of any kind of loose rock, the difficulty and expense of supporting it in the main passage, and in the working places of the mine, will necessarily be very considerable; and, to lessen this as much as may be practicable, the mode of working pursued should be such as will require the least number of passages, and consequently the smallest quantity of standing timber, or other means of support likely to incur constant expense. The character of the roof may be considered as being mainly of three classes, namely:—1st, a very broken friable shale; 2nd, a moderately firm roof, but consisting of several beds of shale, or of tough siliceous grits containing many threads or slips, where breakage easily takes place; and 3rd, a compact, sound roof, which will stand over very large areas without any means of support after all the coal has been worked away from under it. It is very evident that these different classes of roof will require distinct modes of working, so as to reduce the cost and the possibility of accidents to a *minimum*.

In most cases there are a few feet of soft fire clay forming the floor of coal seams, and when the weight of the rock-mass above the seam is put in motion by working away a portion of the coal, it causes the floor to rise up, producing what in some colliery districts is technically called the "Creep." See fig. 2, where C indicates the coal, R the roof, and F the floor raised up by the weight of the roof upon the coal. If the rock forming the floor contains any carbonate of lime, or indeed any mineral substance which readily admits of decomposition from exposure to a moist atmosphere, or dampness of any kind, the "Creep" is almost sure to follow the admission of water into the working places; or a deficient ventilation, causing the air to become saturated with moisture, will produce similar results. A like mineral composition of the roof stratum, when subject to similar conditions, often causes a roof which, when first made, was a very good and favourable one, to become in a short time excessively troublesome and expensive. It is no very uncommon thing for a seam of coal a few inches in thickness to occur a little way above the main workable seam; and from this and other coaly portions of the roof, or from bituminous shale, large quantities of gas are often produced. The make of gas from these sources, especially if accompanied with a little water, or even merely dampness, invariably causes a bad, troublesome roof. It is somewhat remarkable that by draining off gas and water from a district of virgin coal by exploring drifts, the roof, however bad it may have been in the first drivages, is commonly found to be wonderfully improved in the ordinary working places following the exploring operations: indeed, in a pair of

FIG. 2.

R



C

F

exploring drifts, it has been found that when both were kept up to the same line of advancement the roof in both drifts has been badly broken and loose, and very difficult and expensive to maintain; but that when one drift has been kept several yards in advance of the other the advanced one has had a bad roof, requiring close timbering, while the rear one has had a roof sound and safe, and not requiring a single prop. In addition to the decomposition of carbonates already noticed, intense, and often extensive chemical action frequently takes place in the decomposition of iron pyrites contained in the roof, or in the coal bed itself, by which sulphates of iron and sulphates of alumina are produced. Where this is liable to take place to such an extent as to set fire to the coal by the heat, the method of working should be so arranged as to leave nothing behind in the back mine, or waste, but what is valueless, and consequently need not again be sought after.

III. THE RELATIVE POSITIONS OF TWO OR MORE SEAMS TO EACH OTHER.—Two, and sometimes three or more coal beds are situated so closely together, that the working of one must be preparatory to working the others. Where only a few inches, or, at most, a few feet separate one seam from another, the working of the several beds will be proceeded with as if they were together forming one thick seam;—the separating shale would of course make some difference, but the leading points in the methods of working would be the same in both cases. Where the intervening shale is several fathoms in thickness, it then becomes a question of importance to consider whether the upper or lower coal should be worked first. In deciding this question, the following particular points should be considered,—although it must always be borne in mind that, in many cases, this question can only be decided by direct experience, which, indeed, in all cases, is the most safe and satisfactory means. These points are: 1st. The character and thickness of the intervening rock, and the thickness of the lower seam, as indicating whether the separating strata, in settling down—after first working the under coal—is likely to break up to the seam above. 2nd. If fire-damp is produced in large quantities by working the lower seam, how far this may interfere with the safe and economical working of the upper one. 3rd. Supposing water to be liberated from the roof by working an upper seam, in what degree may this be expected to increase the danger and difficulty of working the under one. 4th. The structure and tenacity of the respective seams must also be taken into account; for, by working an under seam, if that next above it be friable, the latter may be so crushed as to cause much waste in working it, and materially lessen its ultimate value; while if, on the other hand, it be a hard seam, working the one below it may facilitate its extraction without increasing the danger to the workmen. From experiments made by George Elliott at the Usworth Colliery, Durham, it appeared that working an under seam lessened the working expenses of an upper one, in one part of the pit; while, in another part of the same pit, and on the same seams, the contrary was found to be the case. It is therefore evident that in some cases it may be advisable to work an upper seam first, while in others the greatest ultimate advantage will be gained by first working the under one. Thousands of tons of

coal are wasted, and many thousands of pounds uselessly thrown away by inattention to this subject; or, at any rate, by not carefully and practically investigating it. Owners of estates containing workable coal beds would find it greatly to their advantage to keep a stricter supervision by competent engineers over the operations of their lessees than is customary in many cases. Thousands of acres of good workable coal seams have been ruined by the lessee working the best seams first, regardless of the ultimate loss sustained by the owner. The waste of so much of that valuable national possession, with which these islands are endowed in such a remarkable manner, is a matter demanding the serious consideration of the Government. Extravagant and wasteful modes of working, which must ultimately impoverish the national sources of wealth and prosperity, are moral transgressions upon the heritable rights of the generations to come, the penalty for which the nation must itself suffer at some future period.

IV. SURFACE CONDITIONS FROM UNDER WHICH THE COAL IS TO BE WORKED.—In working out a bed of coal, or a series of beds, over an extensive area, the strata, even from very great depths, is likely to break up to the surface, unless the space made by excavating the coal is closely built up, or "packed," with some kind of material,—as the broken rock from the roof, or the refuse rubbish made in hewing the coal. The effect of such a break up is frequently to admit the surface water to the workings of the mine, or damage the buildings or other constructions at the surface. Indeed, even where the space can be closely packed, it would still be too great a risk to work away *all the coal* from under a sea, lake, river or any other dangerous accumulation of water; as even then there would be great danger of fractures extending from the subterranean workings to the water at the surface. By incautious proceedings under such circumstances, collieries have been for ever lost, accompanied often by great sacrifices of human life.

In all colliery districts, cases of damage to buildings, railways, bridges, &c., are constantly met with, and the question, as to whether the profits from the coal workings will more than cover surface damages caused by working it, requires, in all cases, very careful deliberation. In some places, there are large accumulations of water in the strata, several fathoms from the surface. This may be expected where the surface rocks are new red sandstone, or any kind of loosely aggregated material. Continuous feeders, or currents, may then be anticipated to issue from the top of the first stratum of rock met with in sinking the shaft, whose mineral character or lithological structure is such as to render it impervious to water. As this may be effectually dammed back in the shaft by various means, it will be necessary to pursue such a method of working the coal as shall be least likely to bring this water into the workings. The following question will present itself in this case;—whether it will be most profitable to allow this water to run into the mine, and then raise it again to the surface, or to pursue such a restricted system of working the coal as shall prevent the probability of this? The answer to such a query can only be given, to any purpose, when all the circumstances of each particular case have been fully investigated; and even then it will be frequently difficult to decide which course will produce the most economical results.

One can rarely ever compare two or more sections of pits which have been sunk, but a mile or two apart, without discovering some difference in the number, thickness, or character of the strata composing them. It therefore follows, that the way in which the strata overlying the coal breaks up to the surface, after working all the coal out from beneath it, must vary almost indefinitely. The area of the coal district excavated by one set of workings, and the number and character of the faults intersecting it, are also points of importance, which must be allowed their due share of attention in considering such a question as this.

ON THE

Processes employed in separating Wolfram from Black Tin

At East Pool Mine, Illogan, Cornwall.

A very remarkable discovery has recently been made at East Pool Mine, in the Parish of Illogan, between the towns of Redruth and Camborne. A metalliferous deposit of a very peculiar form, and mixed character, has been met with on the lode (which had been worked in killas) coming down into contact with one of the underground bosses of granite which, in this district, are found to run parallel to the Carn Brea range. This deposit, which has the characteristics of what miners call "a floor," is made up of copper-pyrites, wolfram, and oxide of tin, often mixed most intimately together: indeed, the intimacy of the mixture greatly interferes with the commercial value of the deposit, from the extreme difficulty of separating the different minerals.

This is particularly the case with the tin and wolfram, which are so closely mixed together in the stone that only a very partial separation can be effected by the most careful spalling and picking. After stamping, it is scarcely necessary to say that a separation, by any mechanical process, is impossible, in consequence of the specific gravity of both minerals being nearly the same.

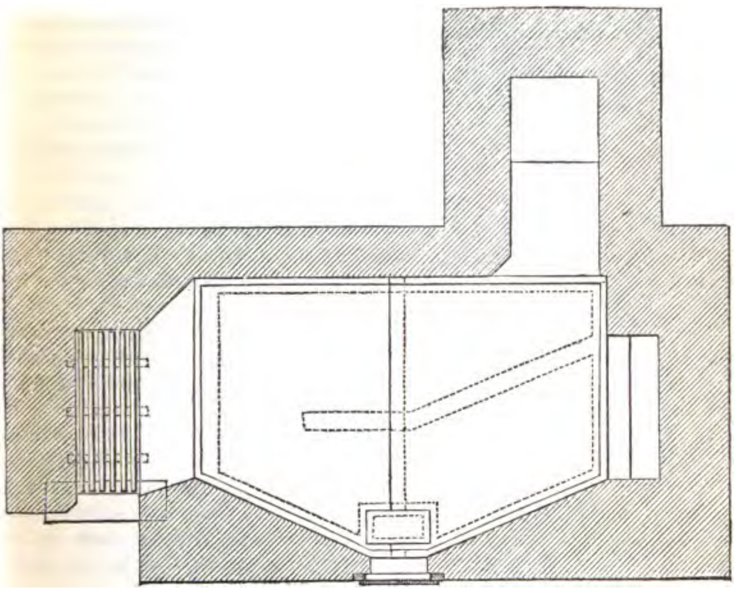
The system adopted at East Pool for separating these two minerals is the chemical one, best known as Oxland's process, from having been patented, in 1847, by Mr. Robert Oxland, of Plymouth. The theory of this process is very simple. The ore, or "work," consisting of a mixture of black tin and wolfram, is mixed with common alkali, or "soda-ash," and treated in a furnace at a red heat. In this operation the wolfram is decomposed, and a soluble salt (tungstate of soda) with oxides of iron and manganese, formed in its place. Theoretically, these products are easily separated from the oxide of tin; but, practically, as will be seen by following the details of the operations at East Pool, this is far from being the case, in that mine at least.

The first operation is to clean the work by the usual mechanical processes of dressing, which separate the ganguey matters; and also by the quasi-metallurgical operation of calcining, which so decomposes the

copper and iron pyrites as to render them easily separated by subsequent washing. When the tin-stuff is thus dressed, so that, under ordinary circumstances, it would be fit for the smelting-house, it is found, at East Pool, to contain from 50 to 75 per cent. of wolfram. This is technically called "wolfram witts," and is ready for treatment by Oxland's process.

The furnace in which this treatment takes place is shown in the three accompanying figures. Fig. 1 is a ground plan; fig. 2 a section

FIG. 1.



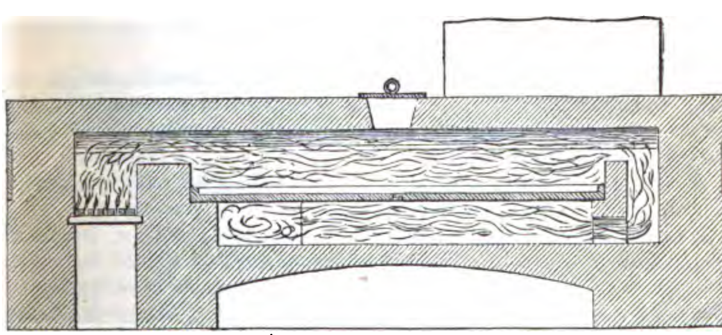
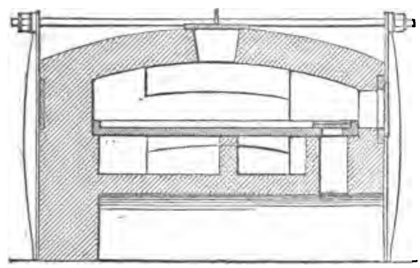


FIG. 2.

along the length of the furnace; and fig. 3 a section across it. These figures sufficiently explain themselves to make a detailed written description unnecessary; but it may be well to point out that the "sole" or "bottom" of the furnace, shown in section in figs. 2 and 3, consists of

cast-iron plate, cast in two pieces, 3 inches thick, each weighing about 30 cwt. The joining of these plates, across the breadth of the furnace, is shown in fig. 2. The same figure also shows how the fire passes, from the fire-place, first over this plate, and then, passing below, again circulates forth and back beneath it before arriving at the flue. The furnace is charged by the top hole shown in figs. 2 and 3, and the charge withdrawn through the hole in the plate shown in figs. 1 and 3. It may be remarked, that the brick top of the furnace has to be taken down and rebuilt when the iron bottom has to be removed and replaced.

FIG. 3.



The alkaline matter used at East Pool is "soda-ash," guaranteed to contain 48 per cent. of alkali, and supplied by the St. Helen's Alkali Company, at £9. 5*s*. per ton, delivered in Liverpool. The freight and carriage thence to the mine is about 20*s*.; bringing the cost, on the floors, to about £10. 5*s*.

The following are the details of the process, which differ considerably, in many respects, from that originally suggested by Mr. Oxland. As the success of the process depends materially upon small details, we have given them with considerable minuteness.

1. Light fire, and make furnace as hot as possible. It is of considerable practical importance to do this *before* putting in the charge.

2. Weigh the charge of "wolfram witts." The weight of this charge should vary according to the greater or less fineness or coarseness of the grain of the witts; the greater weight being used in the case of the rougher work. This weight ranges from 6 cwt. to 9 cwt.; the smaller quantity only being used in the case of very fine work, while the larger quantity may be employed in the case of rough grained work.

3. This charge is then put in the furnace *without* the soda-ash, and made as hot as possible alone. It is important to observe this detail, for the practice of mixing the alkali and witts together before introducing them is found to fail.

4. Weigh the charge of soda-ash. This varies with the quantity of wolfram in the witts, ranging from 9 lb. to 12 lb. per cwt.

5. The charge of witts being previously made red-hot, introduce this charge of soda-ash. When first introduced, it should be spread over the surface of the witts *without mixing*, which is easily accomplished, from its greatly inferior specific gravity. When the whole has been heated, then mix them thoroughly together.

6. Immediately after this first mixing, throw one or two shovels-full of coal over the charge at the end of the furnace furthest removed from the fire-place. It is found, from experience, that without this addition of coals, the fire in this part is not sufficient to carry out the operations successfully.

7. Treat the whole at a white heat for about six hours, stirring and thoroughly mixing it together as frequently as possible—generally, every quarter of an hour. About every half-hour during this period, additional coals must be thrown upon the charge at the far end of the furnace.

8. At the expiration of the six hours, draw off the top half of the charge; then stir remainder once more, after which it may also be drawn off.

When this charge is drawn off hot, it is in a viscous condition, but on cooling it cakes into a mass resembling hard pumice. To separate the tin from this stuff, the following troublesome, costly and wasteful operations have to be gone through:—

The stuff is broken into pieces about half the size of a man's fist, and, being mixed with about 25 per cent. of its weight of quartz-rock, broken to the same size, it is put to be stamped. The stamps used is a small water stamps of seven heads, each weighing 1 cwt., with iron bottoms, and grates. The object of mixing the quartz-rock with the furnace-product is, partly because stuff of that nature cannot be stamped alone without clogging, and partly because the quartz has a peculiar action, which is described as "cleaning off the corode" or hard crust, which seems to form around each separate particle of tin.

The stuff from the stamps is collected in the usual manner, after which it goes through the following mechanical operations: it is buddled seven times, then tossed once, and then put to the chiming keive, where, on an average, it is chimed fourteen or fifteen times. The "roughs" or "crazes" require stamping again, sometimes two or three times (mixed again with quartzose matter), when the stamps are worked as "flashers" without grates. There is frequently, also, a proportion of the work which requires to be again treated with alkali in the furnace.

The cost of working the furnace for twenty-four hours, during which period four charges, of a gross average weight of 30 cwt., can be treated, producing, on an average, 10 cwt. of black tin, is about as follows:—

	£	s.	d.
Coal, 12 cwt.	0	10	0
Labour	0	2	3
Alkali (averaging 11 lbs. per cwt.) 330 lbs.	1	10	0
Materials	0	0	9
	£2	3	0

per 10 cwt., or £4. 6s. per ton of black tin.

The subsequent cost of redressing, and the necessarily large resulting loss, has not been estimated accurately; but the dressing alone is said to cost *double* as much as the original dressing. As this, on the average of the county, is £12 per ton of black tin, and as the dressing of the "tin-witts" would probably cost nearly as much as if it were wholly instead of only one-third tin, the cost of the whole operation must be enormous, and the waste proportionate. We are afraid to say what our own approximate estimate of the cost and waste amounts to.

It is impossible not to think but that there are some peculiar chemical reasons for the great difficulties met with in the separation of the oxide of tin after the treatment with alkali. If these were investigated by competent enquirers, we are convinced that some means would be found by which the present purely mechanical methods might be aided by chemical means. If so, an immense boon would be conferred on the mine in question, as well, no doubt, as upon many others, in various localities, where similar mixtures occur. Our object in preparing this article, besides that of affording a practical working description of Oxland's process, is to give such a publicity to the matter as may lead to its thorough ventilation.

We have, with this object, already placed samples of the tin-witts and the furnace-product before Dr. Percy, who has kindly undertaken to give the matter his attention. When his "Metallurgy" reaches the subject of tin, we may expect to see the results of his investigations. In the meantime, we are sure that the manager of East Pool, Captain W. S. Garby, of Redruth, will readily afford samples and information in reply to any serious enquiries.

Description of the New Form of "Fixed-Frame" in use at Cook's Kitchen, and other Mines in West Cornwall.

A NEW form of frame has recently been introduced at Cook's Kitchen Mine, near Camborne, by the manager, Capt. Charles Thomas (of Dolcoath) and the dressing agent, Capt. William Vincent; and from thence has been adopted by numerous other mines in West Cornwall.

The arrangements of this frame differ materially from the ordinary form hitherto used, where the frame is supported, on pivots, some distance above the surface, and is turned over every time it is washed. This continual turning back and forward, on the pivots, necessarily gives rise to a continued strain, tending to throw the frame out of a true level which is a necessary condition to its perfectly successful working. Where a great number of frames are employed, in the treatment of poor slimes, it results that there are either continual repairs going on, or that the frames are permitted frequently to remain in an imperfect state.

The body of this frame, drawings of which are shown in figs. 1, 2 and 3, is fixed immoveably on the ground. It is separated into any number of divisions required according to the quality of the slimes: in the drawings it is shown separated into three divisions (which is the usual arrangement), at the foot of each of which a launder is placed.

Fig. 1 shows the position of the frame while the slimes are being admitted. These are introduced from the transverse launder shown at the top of the frame, and distributed, as in a buddle, by radiating guides, equally over the top of the frame. In this position of the

frame, the "laps" over each launder are closed, so that the slimes flow continuously, from the top of the first division to the bottom of the last, into the lowest launder of all, where the tailings escape. As in the ordinary frame, the tin is arrested on each division of this frame in proportion to its quality; the best work remaining on the upper division, the next on the second, and so on.

When the slimes have flowed over the frames the necessary time—about the same as in the ordinary frame—and require to be washed down, this is readily effected by pulling up the "vibrating rod" shown in figs. 1 and 2. The upward movement of this rod reverses the

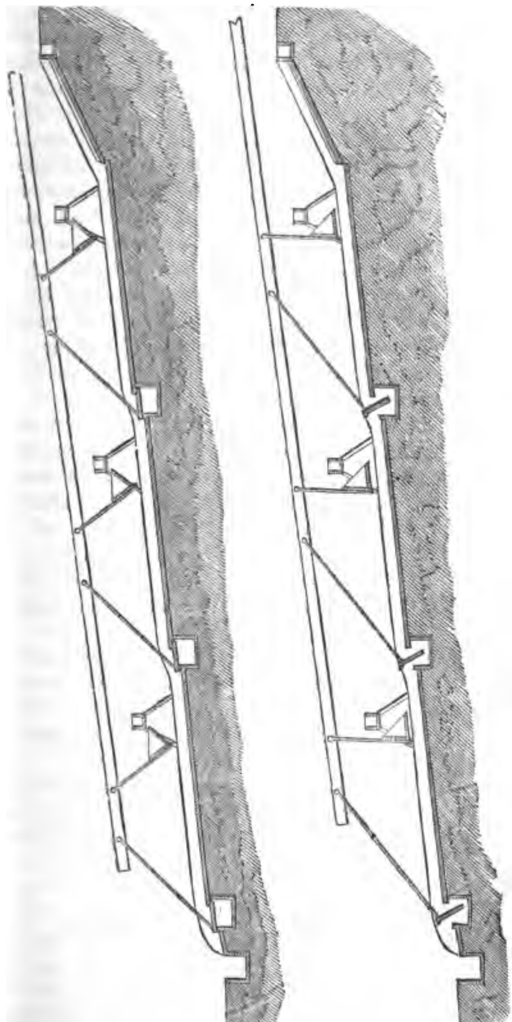


FIG. 1.

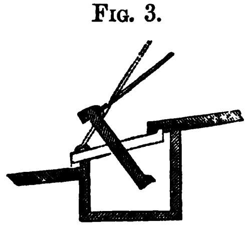
FIG. 2.
Scale 1/60th.

three saddle-back launders, suddenly emptying their contents on the top of the frame; while, at the same time, it opens the laps at the

foot of each division of the frame, by means of the connecting "expansive loop." This sudden dash of water at the head of each division of the frame, washes off its contents into the respective launders, by which they are carried to the different catch-pits. Fig. 2 shows the vibrating rod thus drawn up, the saddle-back launders reversed, and the laps open.

Fig. 3 gives, on an enlarged scale, a more detailed section of the mode in which the lap is made to close over the launder between the divisions of the frames. It was a matter of some difficulty at first to make this lap close so as to prevent some of the slime escaping into the launder: but this has been entirely obviated by adopting the details shown in fig. 3.

FIG. 3.



Scale 1/15th.

The other details are sufficiently shown in figs. 1 and 2 to dispense with any lengthened description. The saddle-back launders are supplied with water by small transverse launders, supported on brackets. The pivots of the saddle-back launders (which are put in with two screws) are also supported on these brackets. As the length of the stroke of the vibrating rod necessary to upset the contents of the saddle-back launder is much greater than that required to open the lap, the latter is connected with the rod either by means of an expansive loop or a small chain; the former being preferable, as the latter hangs loosely down when the lap is closed.

The vibrating rod can either be pulled up by the attendant girl as the frame requires washing, or it can be moved at regular intervals by a flap-jack, or any other contrivance. A flap-jack is used at Cook's Kitchen. The fall given to the frames differs to some extent at different mines: it generally varies between 1 inch and 1½ inches to the foot. In the figures the upper division has a fall of 1½ inches per foot, and the two lower divisions 1 inch per foot. The launders conveying away the slimes from the different divisions have a fall of 1 in 6.

A considerable number of these frames—from six to twelve—are generally placed side by side in a row, and can be attended on by one girl. The mechanism is so simple that scarcely any repairs are required. The time occupied in washing down the frames also is so trifling that it is not necessary to cut off the flow of the slimes.

Of course these frames are not intended for rich work, which must be still left to be treated by the old hand-frames. They are intended to supersede machine frames for poor work now so abundant in Cornwall.

Hundt's Concave Circular Buddle.

ILLUSTRATED BY PLATE I.

THIS form of buddle was first invented four or five years ago by Herr Hundt, a mining engineer of Siegen, in Prussia. It was described in No. 26 of the *Berggeist*, and subsequently in an early

part of the *Zeitschrift für das Berg-Hutten-und Salinenwesen* for 1858, vol. v., page 65 of the *Abhandlungen*. In the following year (1859) two other papers, on the same subject, appeared in the *Zeitschrift*, showing several improvements in the details of the arrangements. From a plate accompanying one of these papers, the drawings of our Plate I. are taken. We give this plate with little alteration from the original, to show the history of the machine.

The principle on which this buddle is constructed is that of securing the largest amount of concentrating area for the "heads," and at the same time admitting of the separation of a greater proportion of the waste than can be effected in the ordinary round buddle. The latter result is due to the circumstance that the area over which the stuff has to be distributed is gradually *contracting*, thereby *increasing* the velocity of the flow, and enabling it to sweep off a proportionate quantity of the lighter matters associated with the ore.

It is due to our own countrymen, Messrs. Phillips and Darlington, and Captain William Hollow, of Providence Mines, St. Ives, Cornwall, to state that this form of buddle was conceived independently by them, subsequently to Herr Hundt, but without any knowledge of his invention. The application of the revolving distributor is, however, entirely due to Herr Hundt, and as this adds materially to the practical value of the machine, the greater part of the credit of the invention must be admitted to be due to him.

That this form of buddle is a great improvement on the old round buddle cannot, we believe, be doubted. Experiments made in Germany with lead ores have been greatly in its favour; and the success of several recently put up at Providence and other tin mines in West Cornwall is equally decisive in its favour.

Description of Plate I.

a represents the end section of an ordinary slime trommel, over the outside of which the launder *b* discharges clean water, for the purpose of keeping the holes open. *c* is the inflow slime-launder, delivering the slimes into the central trough *d*, which is fitted concentric with, and is supported by, the vertical axis *e*. This also carries the four arms *f*, *f*, *f*, *f*, which are connected to and revolve with the central trough. *g g* are light wooden bars (having the same inclination as the floor of the buddle) connected with the arms *f*, *f*, *f*, *f*, by the vertical sliding braces *h*, *h*, *h*, *h*, which—as in the case of the ordinary round buddle—can be raised or lowered as required by the regulating screws shown in the drawing. Attached to each of these wooden bars (*g*) is a piece of canvas *i*, serving also, as in the ordinary round buddle, to give an even surface to the work when the arms are rotating. *k* is the floor of the buddle, which has a fall, varying with the nature of the work to be operated on, from the periphery to within a certain distance of the central opening, where it is horizontal: this fall, of course, varies with the nature of the stuff to be operated on, and is best decided by experience. *l* is the central annular opening for the escape of the tails, which pass off by the launder *m*. *n* is the arbor which, moved by any convenient motive power, gives

motion to the whole apparatus—to the arms *f*, *f*, and also the diagonal distributing launders *o*, *o*, *o*, *o*. These distributing launders are in communication with the central trough *d*, from which, in their revolution, they carry the slimes to, and distribute them at, the outer edge of the buddle: they act best when they terminate with an elbow *p*, as shown in the ground-plan. These distributors, instead of being launders, may conveniently be made of light zinc piping.

The speed at which the arms and diagonal distributing launders should be made to revolve varies with the nature of the work from 8 to 16 revolutions per minute. The quantity of slimes admitted will also, of course, vary with this speed; but these are evidently matters only to be satisfactorily decided by experience.

An addition has been made in some of the buddles put up in Cornwall, of an annular sliding ring round the central opening *l*, which is raised as the tails accumulate. This addition does not appear to have been adopted in Germany; it complicates the machine, and has not been shown to possess any practical advantages which are not equally gained by making the central part of the buddle horizontal. This, however, is not a matter to be decided without further inquiry.

Mineral Statistics of India.

THE third volume of the "Memoirs of the Geological Survey of India" contains a paper dated Calcutta, 1st June, 1861, by Mr. Thomas Oldham, M.A., F.R.S., Director of the Geological Survey of India, on the coal statistics of that country. The universal interest now felt regarding the industrial progress of our great dependency cannot fail to make the information given in Mr. Oldham's paper of general interest.

Mr. Oldham prefaces his tabular statistics with the following remarks:—

"The accompanying returns give as full and complete data regarding the actual amount of coal raised throughout India generally as I have been able to procure. It is not supposed that a first attempt of this kind may be free from errors, or mistake. All that can be expected is, that all proper precautions have been taken. In this respect I may state that, with the exception of the smaller workings in the Rániganj field, the produce of which was obtained at the pits themselves, and with all possible precaution of repeated enquiry and cross-questioning, the amounts given below are those stated to me under authority of the several proprietors, agents, or secretaries of companies, &c., and these proprietors thus become responsible for the accuracy, each of his own return.

"There are still a few collieries known to be at work, from which I have not succeeded in obtaining any return. These are those at Kotah, Singrowli, &c.: but the out-turn of these is known to be small, and would not seriously affect the general result.

"The returns are given for three years past; that is, from the 1st of October or November, 1857, to the same date 1860. This is, by custom, considered the close of the 'coal year,' from the circumstance that, until recently, the only mode of conveyance for coal from the Ránigani field was by the River Damuda; and as the accounts were closed, when, after the rainy season, the river had so diminished in the amount of its waters, that there appeared no chance of sending any more coals to market that season—this period thus became the customary close of the local year.

"The total returns give an average out-turn of coal for the past three years of 87,37,454 maunds, or about 320,631 tons. But it is scarcely just to consider this as giving a fair mean of the present out-turn, for during the first of these years there

were, as is well known, disturbing causes at work tending to injure the regular trade of the country; and a fairer average, though determined by too small a number of years, will be obtained by taking the mean of the last two years' produce. This will give 100,25,020 maunds, or about 367,890 tons in the twelve months.

"The returns also show one important and interesting fact, namely, that however the local out-turn may have increased or diminished, as affected by local causes, the general out-turn has steadily and markedly increased, apparently indicating a healthy and sound extension of trade and commerce.

"The total out-turn for 1860 (that is, for the twelve months ending October, 1860) was 100,88,113 maunds, or 370,206 tons; an amount almost contemptible (about the 200th part) if compared with the wondrous total of the coals raised annually in Great Britain, viz., 72 millions of tons! but still evidencing a large and increasing commerce, and the spread of many of the arts of civilization.

"To the table a few notes have been appended, referring to other parts of the country where coal is either known not to occur, or where it may have been found in small quantities, but is not workable.

"The tables commence with the details of the Ránigaj coal field, by far the most productive as well as important coal field in India, and the other localities are referred to afterwards.

The first table gives a "List of the Collieries worked in the Raniganj Coal Field during the years 1858-59-60, with Statistics of the Methods of Working employed, Out-turn of Coal, &c., &c." In this table 50 collieries are enumerated, the information and statistics respecting which are arranged in eleven columns under the following heads:—(1) *Number;* (2) *Name of Colliery;* (3) *Proprietors;* (4) *Method of Working* (by quarries or pits); (5) *Number of Pits or Quarries in work;* (6) *Date of first establishment of Colliery;* (7) *Out-turn of "Round" Coal in Maunds for the years ending September 30th*, 1858-1859-1860; (8) *Number of Steam Engines, and Horse-power;* (9) *Thickness of the Coal Seam in feet;* (10) *Thickness worked in feet;* (11) *Remarks.* The 50 collieries in this coal field are classed into the five following divisions:—

I. *Mines in the Singaran Valley*, comprising twelve collieries, worked by means of eighteen pits and ten quarries, and employing eight steam engines. The most productive concern in this division seems to be the Mangalpur colliery (Messrs. Erskine and Co., proprietors) worked by seven pits and three quarries, employing two steam engines (one of twenty-five and another of ten horse power), and producing in the year ending September 30, 1860, 1000000 maunds of round coal. In this colliery the thickness of the seam worked is 15½ feet; but the "remarks" give the following note:—"In the quarries 9 ft. of shale and inferior coal, overlying the seam, improve in quality, and are worked, making the whole 24½ ft." The Bengal Coal Company worked four collieries in this division, only one of which, however, Harispúr, turning out 440000 maunds, and employing one steam engine of twenty horse power, is worthy of notice. The East India Coal Company worked three collieries in this division, producing, in 1860, 330000 maunds, and employing two steam engines of thirty and forty horse power respectively. One of the seams worked by this company is 22 feet thick. Messrs. Nicol and Sage also worked a productive colliery, employing two steam engines (twenty-five and eight horse power), which, however, only produced 264584 maunds in 1860, against 485000 in 1859. The bed wrought in this concern is 15½ feet thick.

II. *Mines in the Neighbourhood of Rániganj*, the most productive division in the coal field, comprising ten collieries, worked by means of twenty-five pits and fourteen quarries, and employing eleven steam engines. The most extensive concern in this division is Ràniganj colliery, commenced in 1816, worked by the Bengal Coal Company, by twelve pits, employing six steam engines (ranging from thirty-five to four horse power), and turning out 1600000 maunds in 1860 (against 1900000 in 1859). The bed wrought in this colliery is 13 feet thick. The Bengal Coal Company also work four other concerns in this division, producing together 825000

maunds. Messrs. Erskine and Co. likewise work two collieries; and the East India Coal Company one. A native proprietry (Bábú Gobind) get from two collieries the large turn-out of 1842000 maunds, employing two steam engines. In these concerns the bed of coal is 20 feet thick, all the thickness of which is worked in the quarries, but only 10 feet in the pits.

III. *Mines in the Núnia Valley, Eastern Division*, comprising thirteen collieries, wrought by means of five pits and ten quarries, employing two steam engines (of eleven and twenty-five horse power respectively). The collieries in this division are not large, only two reaching an out-turn of 100000 maunds in 1860, although others reached a higher produce in former years. Messrs. Erskine and Co. and the Bengal Coal Company appear among the proprietors; who, however, are chiefly natives. The thicknesses of the seams worked are given at 17 feet, 12 feet, 9 feet, 8 feet, and as thin as 5 feet.

IV. *Mines in the Núnia Valley, Western Division*, comprising five collieries, wrought by three quarries and five pits, employing three steam engines (of thirty-two, thirty and eighteen horse power.) Four out of the five collieries here are worked by Messrs. Apear and Co.; the most productive (Fattipúr) gives an out-turn of 150000 maunds in 1860, against 200000 in the previous year. The thickness of the seam of coal is from 10 to 12 feet.

V. *Mines in the West of the Field, and others not above specified*, comprising ten collieries, wrought by seven pits and nine quarries, employing three steam engines (of twenty, ten and eight horse power.) The principal proprietors in this division are the Bengal Coal Company, one of whose collieries turned out 329000 maunds in 1860. Messrs. Erskine and Co. also work a concern giving an out-turn of 200000 maunds; and the East India Coal Company and Messrs. Nicoll and Sage are also named as working collieries here. Among the ten collieries enumerated, six are stated to be in the Lower Damúdas, the others being in the Ániganj series. The seam varies in thickness from 35 and 33 feet (in some of the collieries in the Lower Damúdas), down to 18, 10 and 8½ feet.

GENERAL ABSTRACT OF OUT-TURN OF COLLIERIES IN THE RANIGANJ COAL FIELD.

N.B. The Ton is calculated at 27¼ Maunds.	1858.		1859.		1860.	
	Maunds.	Tons.	Maunds.	Tons.	Maunds.	Tons.
I. Singáran Valley......	878000	32220	2370600	86994	2201584	80792
II. Neighbourhood of Ániganj.........	3573000	131119	4706000	172697	4666884	171261
III. Núnia Valley (East Division)	465000	17064	680000	21284	472737	17348
IV. Ditto (West Division)	270000	9908	320000	11743	290000	10642
V. West of the Field, and others	731000	26825	873000	32036	927892	34051
	5917000	217136	8949600	324754	8559097	304094

The second table gives "A List of the Collieries worked in the RAJMAHAL "HILLS, and other places in India, during the years 1858, 1859, 1860." The Rajmahal Hills Country is divided into four groups of collieries, as follows:—

1. *Brahmini Nuddi and Neighbourhood*, comprising seven collieries, turning out altogether under 100000 maunds in 1860, the beds varying from 13 to 3 feet in thickness.

2. *Bansloi Nuddi and Neighbourhood,* comprising likewise seven collieries, giving a turn-out of only about 80000 maunds, the beds varying from 19 feet to 3 feet in thickness.

3. *Goomani Nuddi and Neighbourhood,* comprising three collieries, only two of which, belonging to Mr. Burke, are worked to any extent. These turned out 260000 maunds in 1860.

4. *North-West of Hills,* comprising also three collieries, two of which, worked by the East India Railway Company, turned out 700000 maunds in 1860.

No steam power is employed on any of the collieries of the Rajmahal Hills.

The other coal fields enumerated are—

The KURHURBARI COAL FIELD, in which two collieries are named, one worked by the East India Railway Company, employing a four horse power steam engine, giving a turn-out of 275256 maunds in 1860.

The PALAMOW COAL FIELD, in which one small quarry colliery is mentioned as worked by the Bengal Coal Company.

The KHASIA and JYNTEAH HILLS; SINGROWLI and REWAH; and SCINDE (Lynah Valley,) in all of which the extent of workings is insignificant.

The summary of all these gives the following general abstract of the coal produce of India :—

DISTRICTS.	1858.	1859.	1860.
Raniganj Coal Field	5917000	8949600	8559097
Rajmahal Hills	219000	843000	1222860
Kurhurbari	4000	108182	275256
Palamow	...	28648	30900
Sylhet Hills	22319	32498	...
Total in Maunds	6162319	9961928	10088113
Or in Tons	226140	365575	370206

Mr. Oldham concludes with the following observations :—

"Of the Singrowli coal field, which lies to the south of the River Sone, in the Rewah Territory, I have not been able to procure any return. I am, however, aware that the amount of coal raised has been small, and will not materially affect the general total. More than one bed of coal has been practically examined in the continuation of this field to the west and towards Singhpoor. But none of these are as yet at work as collieries.

"The Nerbudda Valley has long been known to contain coal, but owing to the distance from any available market, and the comparative inaccessibility of the localities where it occurs, it has not been hitherto economized. The Nerbudda Coal and Iron Company have this year commenced their operations, and I suppose will shortly be turning out coal.

"In other parts of the North-Western Provinces territory there is no known *workable* coal. Seams of lignite of very irregular size and very limited extent occur in several places along the foot of the Sub-Himalayas, marking a certain group of sandstone rocks, of comparatively recent date; but nowhere are these deposits known to be of extent rendering it probable they will ever be of any practical use.

"In Oude no coal is known to occur. In the Punjab no coal is known to occur, if we except, as above in the North-Western Provinces, the patches of lignite

which have been found in several localities along the base of the outer Himalaya, as well as in the Salt Range.

"In Scinde the only coal raised was that of Lynah Valley, as given above, but the irregularity and the small extent of this deposit has caused it to be abandoned. It was, in fact, an irregular patch of *lignite*.

"In Bombay no coal is known to occur. In Hyderabad none. In Nagpore a small coal field is known near to Umret, on the border of the Nerbudda District, which may, in fact, be considered a continuation (although actually separated) of the Nerbudda deposits. The coal is not now economized.

"In Madras no coal is known. Coal has been more than once stated to occur on the Godavery, or some of its feeders; and even very recently; but as yet nothing but black shales, which will not support combustion, and which are, in all probability, of a totally different age from the coal-bearing rocks of India, have been met with."

The following general observations, extracted from the "Friend of India," will also be read with interest:—

"Over the vast peninsula of India, which has an area of 800,000 square miles, coal is found only in the valley of the Ganges and neighbouring hills, in Rewah, to the south of the Sone, in the Nerbudda Valley, and in the Sylhet Hills, in the far north-east. There is no workable coal elsewhere in the north-western provinces; none in Oude, the Punjaub, Scinde, Bombay, or Madras. This fact is the less cheering that iron and lime are generally associated with coal in the same formation, and that India, except in the east, is comparatively destitute of these great elements and necessities of modern civilization. It is no great consolation to say that where coal exists it is abundant; that Bearbhoom, for instance, is one mass of mineral wealth. India is as large as Europe, and the coal of Raneegunge or lime of Sylhet is more useless to the cotton mills and building firms of Bombay or Madras than that of Newcastle is to Moscow. Coal is most bulky for carriage, and railway carriage will always be so expensive that it will probably be cheaper for Bombay to use good English than indifferent Bengal or even Nerbudda coal. * * * * * Our readers will form a better estimate of the coal-producing power of India, if we place in order, with the assistance of Mr. Hunt's mining records, the out-turn of all the coal countries in he world in 1857. We regret Mr. Oldham has not given the proportion of the coal area to that of the whole country:—

Countries.	Proportion of area.	Production in tons.
British Islands	1.10	66,000,000
Belgium	1.22	5,700,000
France	1.100	4,500,000
United States	2.9	4,500,000
Prussia	1.90	3,500,000
British North America	1.20	900,000
British India	......	370,000
Bohemia	1.20	300,000
Spain	1,52	250,000

Of the nine countries, India is already seventh on the list. What a future for America is involved in the fact that nearly a fourth of her whole area, as far as is investigated, is covered with coal! India raises a third more than Spain, and about the same as Warwickshire. The consumption of coal in India and by vessels leaving its ports we may estimate at 700,000 tons annually, the amount imported in 1857 from England being 329,157 tons. Reckoning the price of Indian coal in Calcutta at 5 annas a maund, or 17*s.* a ton, and English coal at the same rate (though it is far higher), we have more than £500,000 sterling spent on coal every year in India. As the trade and manufactures of India increase, and as machinery comes to be more and more largely introduced, indigenous coal will become more important. The fact that the supply is in certain districts inexhaustible, and that the demand is annually increasing, is one full of hope for the coal companies and proprietors who already occupy, or, like the Bengal Company, monopolise the field. It is possible the Nerbudda fields, worked by the company just established, may supply Bombay and the southern portions of the north-western provinces on the completion of the railway. But Oude, the Punjaub, and Madras must still look to their forests, which, on both sanitary and commercial grounds, it becomes daily of more importance to utilize and renew."

The "Standards" of Tin Ore.

To most people not intimately acquainted with Cornish mining, the system of computing the quantity of black tin in the stone, or even the mode of estimating the money value of this black tin from the "standards" fixed by the smelters, is an almost inextricable riddle. Local customs have certainly managed to involve a matter, simple enough in itself, in a very unnecessary amount of complication; as M. Moissenet very justly says—"*on arrive à introduire des complications, presque mystérieuses, là où une simple règle de trois pourrait suffire.*" As we shall continually have occasion to refer to both these points, and assume an acquaintance with them on the part of our readers, we think it advisable to give a short explanation of them. Next month we shall explain the various systems of computing the tin in the stone; confining ourselves on the present occasion to explaining the mode of estimating the money value per ton of black tin from the "standard." This is very simple. The first step is to find the "produce," which is estimated at so much in 20. This is done by trying a sample of 1 ounce = 20 dwts. in a crucible with a proper mixture of anthracite (generally about 5 dwts.) for reducing the oxide, and sometimes a certain proportion of borax for flux. The weight in dwts. of the button resulting from this assay is the "produce" of the sample—let us say 13¾ in 20 (which equals 68¾ per cent.) From this "produce" of 13¾, a fixed deduction (which remains the same whatever the produce may be) of 1¼ is made for "returning charges," which reduces the "nett produce" to 12½. The "quality" of the metallic tin is next examined into, and its class is fixed as "common" or "fine," as the case may be. A "standard" being fixed periodically by the smelters for each of these qualities, the money value is found by *multiplying the standard by the nett produce, and dividing by* 20. For example, let us take the instance assumed above of a produce of 13¾, and let us suppose that the quality of the tin was "common." We then have 13¾, less 1¼ (for retaining charges) giving the nett produce as 12½. At the time we write the standard of "common" tin is £109, to which, if we apply to above rule, we have—

$$\frac{£109 \times 12\frac{1}{2}}{20} = £68\ 2s.\ 6d.,\text{ value per ton of the black tin.}$$

Besides the allowance of 1¼ for "returning charges," the smelter also receives an allowance of 3 lbs. per cwt. for "wastage;" the black tin being weighed off at 115 lbs. to the cwt., or 20 cwt. 2 qrs. 4 lbs. to the ton.

From the above data an adventurer in a tin mine is in a position at once to ascertain what his black tin should realize per ton, knowing the "produce" and quality, which he can at any time ascertain from a sample of the black tin. The two following examples may make the matter still plainer:—

With a sample of black tin, giving a produce of 13½ "common" tin, find the value per ton, the standard for common tin being £111. If from 13½ we deduct 1¼, we have 12¼ for "nett produce," which gives us—

$$\frac{£111 \times 12\frac{1}{4}}{20} = £67\ 19s.\ 9d.,\text{ value per ton of black tin.}$$

With a sample of black tin, giving a produce of 13¼ "fine" tin, find the value per ton, the standard for fine tin being £114. Deducting the 1¼, we have 12 for nett produce, which gives—

$$\frac{£114 \times 12}{20} = £68\ 8s.,\text{ value per ton of black tin.}$$

Almost all the tin ore raised in Cornwall is sold by private contract at prices calculated, by this means, from fixed standards.

List of Copper-Smelters in England and Wales:

CORRECTED TO JULY, 1861.

(From Dr. Percy's "Metallurgy.")

PROPRIETORS.	NAME OF WORKS.	LOCALITY.
Pascoe Grenfell and Sons	Middle Bank	Swansea
Ditto	Upper Bank	Ditto
Vivian and Sons....................	Hafod	Ditto
Ditto	Taibach	Aberavon
Williams, Foster and Co.	Morfa	Swansea
Ditto	Landore	Ditto
Ditto	Rose	Ditto
Ditto	Crown	Neath
Sims, Willyams and Co.	Llanelly	Llanelly
Copper Miners' Company	Cwmavon	Aberavon
Mona Mining Company............	Mona	Amlwch
Keys and Son........................	Whiston	Cheadle
British and Foreign Company } Newton, Keates and Co. ...... }	Parr..................	St. Helen's, Liverpool
Newton, Keates and Co.	Sutton	Ditto
Bibby, Sons and Co.	Ravenhead	Ditto
Mason and Elkington	Pembrey............	Near Llanelly
Charles Lambert	Port Tennant......	Swansea
Ditto	Widnes Dock	Liverpool
Frederick Bankart	Red Jacket.........	Neath
Sweetland, Tuttle and Co.	Briton Ferry	Ditto
Vivian and Williams..............	White Rock.........	Swansea
Williams and Vivians and others	Mines Royal *......	Neath
James Radley.......................	Pocket Nook	St. Helen's, Liverpool
Bold Copper Company	Bold..................	Ditto

* Incorporated by Royal Charter, James I., A.D. 1564.

The "Standard" of Copper Ore, and the Associated Copper-Smelters.

(FROM DR. PERCY'S "METALLURGY.")

THE STANDARD.—The term *standard* is one in common use, but is generally quite unintelligible to persons not actually engaged in copper-smelting. For the following history of its origin, and explanation of its present meaning, I am indebted to Mr. Keates, who designates it as an "everlasting stumbling-block of copper-trade technicality."

Originally there were few copper-smelters and few miners, and it was customary for the former to contract with the latter to buy their ores for periods varying from a quarter to one year, agreeing to pay them for the same according to a *standard* price of copper determined on, and which price was usually the selling-price of *tough-cake* copper at the time. Thus,

if copper were selling at £120 per ton, the *standard* was fixed at that rate, or thereabouts. Out of this *standard* price the miner returned to the smelter a certain sum on every ton of ore sold, which for many years was fifty-five shillings per ton, though originally it was more. This was called the *returning charge*. The miner also gave the smelter 1 cwt. of ore upon every ton, to cover waste on removing the ore from the mine to the smelting-works: the smelter was also allowed a varying number of pounds of ore in each ton as compensation for moisture in the ore, the bulk being weighed *wet*, while the assayer's sample was weighed *dry*. *Examples*:— Suppose a bargain made, and the ore weighed by the miner to consist of two parcels, one of 1004 cwt., which is guessed to contain ½ cwt. of moisture per ton; the other of 800 cwt., which is guessed to contain ¾ cwt. of moisture per ton; so that in the first case the quantity of ore *paid* for is only 46 tons, 14 cwt. 1 qr., and in the second it is only 36 tons, 15 cwt. 2 qrs. Let the first parcel produce by assay 10½ per cent., and the second 5¼ per cent. of copper. In the first parcel the gross value of the copper in the ton of ore will be £12. 12*s*., the standard price of copper being £120. For 100 parts of copper (say 1 ton) : £120 : : 10½ parts : £12. 12*s*. But from this gross value of the copper in the ton of ore the returning charge must be deducted. Thus, gross value of the copper, £12. 12*s*.; returning charge, £2. 15*s*.; price per ton of ore, £9. 17*s*. In like manner the price of the second parcel of ore will be found to be £3. 11*s*. Thus far the term *standard* is simple and intelligible, meaning neither more nor less than the *price of copper*.

The sources of the smelter's profits were the care with which he got his ores transported from the mine to his works, so as to save as much as possible of the 1 cwt. of ore in each ton which he did not pay for, the portion of the £2. 15*s*. returning charge which was not actually expended in smelting, and the *surplus* or quantity of copper which his furnaces yielded in excess over the crucible of the assayer; and this of course would vary with the skill as well of the assayer as of the smelter. Originally copper ores were dressed to a pretty uniform rate of produce, perhaps from 9 to 12 per cent., and, *whatever the produce*, the standard did not vary. By and by the ores were not dressed so uniformly; some came to the market, say of 15 per cent. produce, others of 5 per cent. But the smelter, more acute than his neighbours, saw that he had better buy those of 5 per cent. and leave the others, because it took a much less portion of £2. 15*s*. to smelt a ton of ore of 5 per cent. than a ton of ore of 15 per cent. produce.* Now, the simple mode of meeting this was to have had a varying scale of returning charges, instead of which these charges remained the same, while the standard was varied with the varying produce of the ores, so that, with copper at £120, there might be a standard of £115 or £130, and thus the word standard lost its former simple and correct meaning. Competition went on increasing, processes were improved, carriage, freights, coals, &c., were lowered, but the *returning charge* continued the same, with, of course, less applicability than ever to the varying produce of the ores.

An illustration of what actually occurs at a modern sale will make the matter plain. Out of a modern sale of 3,000 or 4,000 tons of ore, varying in produce from 4 to 20 per cent., let us select the following lots, with, the prices at which they were sold:—

		£	s.	d.
100 Tons of 5 per cent. produce	....	4	12	0
" 8 "	....	8	1	0
" 12 "	....	12	18	0
" 16 "	....	17	8	0
" 20 "	....	21	15	0

* The father of the late Mr. Vivian, it is reported, was the first person clearly to apprehend this important commercial truth.

The smelter has no longer got his *standard* price of copper arranged with the miner as of old, but he opens his eyes to all the circumstances, or ought to do; he sees what sort of ore he wants; he knows the rate of carriage and freight which he will have to incur on each parcel; he knows that one lot melts easily, another with difficulty; a third makes good copper, a fourth bad, and so on; and in the end, he finds he has bought the five lots of ore above mentioned at the prices affixed. Immediately the *prices* are disclosed in the sale room the miners' and smelters' clerks proceed to calculate *the standard* in the following manner:—

	£	s.	d.
Price of the ore of 5 per cent produce	4	12	0
Add returning charge	2	15	0
	7	7	0

But this sum refers to the *ton of ore*, or 5 per cent. of the *ton of copper*, so that the standard of the ton of copper will be £7 7s. × 20=£147.

Again:—

	£	s.	d.
Price of the ore of 20 per cent. produce	21	15	0
Add returning charge	2	15	0

This multiplied by 5 gives the standard of £122. 10*s*. Hence *the standard is now deduced from the price, and not the price from the standard, as formerly.* The buyer makes his offer without thinking of the standard. When the sale is over the *average produce* of all the parcels of ore is determined, and also the *average standard.* Taking the 5 lots enumerated, the average produce is 12 3-16 nearly, and the average standard £132. 4*s*. nearly. The only purpose which this modern standard serves is a ready mode of comparison of prices or of rates at which *copper in the ore* has been sold.* For instance, instead of saying, last week ores of 5 per cent. produce sold for such a sum, and this week they sold for such a sum, the phrase is, the standard is down a couple of pounds or up £5, as the case may be.

The Associated Copper Smelters.—There are certain of the smelting companies, about half, whose assayers act in concert and assemble weekly, when each presents the results of his assays of the samples of ores announced for sale on a given day. The assayers compare their results and agree upon a uniform list of produces, which is called the "settled list," and by this the associated smelters are supposed to be guided in their biddings for the ores. But this may not always be the case. Thus—suppose the produce of a particular lot of ore to be returned as 9¼ per cent. by the private assayer of a company while it is only fixed at 9 per cent. in the "settled list," the company would probably bid on a produce of 9¼ and *vice versâ.* Admission to this conclave of assayers is believed to be of great advantage, because the error of any individual assayer is sure to be found out and corrected. The strictest secrecy is attempted to be maintained with respect to the "settled list," both the smelters and the assayers of the association in question being under a promise not to impart information concerning their proceedings to any "outsider." The companies have, of course, a perfect right to enter into a combination of this kind, but it is questionable whether it be wise on their part to affect so much mystery, and forbid the publication of the "settled list" *after* the sale. Secrecy engenders suspicion, and people are apt to conclude that deeds are kept in the dark

* The modern standard has not even this small value at present. Miners have long since learned that, unless the produce is the same, the comparison of the nominal average standard of any two sales is no criterion of the price the ore brings; consequently we see regularly in the Cornish papers a supplemental calculation showing how the prices of ores have really gone.—Ed.

because they will not bear the light. Thus many mine-adventurers are under the impression, which may be very erroneous, that all these strict injunctions as to privacy on the part of the associated smelters can have no other object than that of keeping down the price of ores. My own conviction is, that if the "settled list" were published in due course *after* the sale, all cause of suspicion would be removed, and the association would benefit rather than suffer. It has been reported that in making out the "settled list" only the *lowest* produces are selected, and that the average of *all the produces* is not taken; but, from what I have seen, I believe this report to be without sufficient foundation. Evidence on this subject will be presented under the head of assaying in a subsequent part of this work. However, it is confidently asserted, that on one occasion good reason existed for disputing one of the produces set down in the "settled list." The following anecdote, which I received from an excellent authority, may be adduced in confirmation of this statement. Some years ago a rich copper-ore was assayed by a professional assayer of great experience, and reported by him to contain from 30 to 40 per cent. of copper. The produce, whatever it might be, was 5 per cent. higher than that in the "settled list." On the ticketing day, the particular lot of ore was presented for sale, when, on account of the discordance above mentioned, and which came to be known, a proposal was made to withdraw it. Some of the smelters present objected to this proposal, on the ground that it was not likely that the assays of their united assayers should all be wrong, and the assay of a single assayer correct. At this period, the manager of certain copper-works rose, and, with a degree of moral courage which did him honour, boldly avowed that his private assay was 4½ per cent. higher than that of the settled list. This decided the point, and its sale was postponed. It was subsequently sold at a price corresponding to the higher produce of the single assayer. I have recorded this anecdote simply to show that the "settled list" may not, in every case, be quite infallible.

Dr. Percy's Metallurgy.

Metallurgy. The Art of Extracting Metals from their Ores, and adapting them to various Purposes of Manufacture. By JOHN PERCY, M.D., F.R.S., Lecturer on Metallurgy at the Government School of Mines. Vol. I. *Fuel; Fire-clays; Copper; Zinc; Brass; &c.* London: John Murray.

(First Notice.)

THAT a country like England, occupying by far the foremost position in metallurgical industry, should up to the present time have remained without any systematic treatise on the subject, would be unaccountable in the case of any other people. But we are a "practical" people, and—a few years ago, at least—would have rather affected to despise such things; indeed, we have felt a pride, rather than otherwise, in contrasting ourselves with other nations in this respect. Without any special books or any special means of education, there seemed a grandeur in achieving such stupendous results by the mere force of industry, energy and will, and so completely distancing every other nation, notwithstanding their books and their schools.

But of late years, the competition among nations has been as keen as that among individuals. The great wealth and consequent power of this country principally springing, directly or indirectly, from her mineral industry, have excited the emulation of other nations, many of whom have shown themselves no insignificant competitors in the markets of the world. It has become necessary for us, if we are to hold our own in this industrial

contest, to neglect no means of improvement; and consequently the aid of science is now accepted willingly—indeed gratefully—where before it would have been despised. In metallurgy, this is particularly the case. For many years the most successful firms have been those who have brought science judiciously to bear in aiding their practical operations.

Hence the want of an authoritative treatise on metallurgy* has been felt for some time. But wanting a work of this kind, and even crying on the house-tops that it was one that should be written, was not enough to produce it. Let us consider the conditions essential to its being carried out successfully. In the first place, it was necessary that a man should devote no inconsiderable portion of a lifetime to the task: not that this, by any means, was the greatest difficulty. The collection of the necessary information would be the principal impediment—and one only to be overcome by some one occupying an exceptional position. A person wholly disconnected with metallurgical pursuits could scarcely expect to be allowed to penetrate its trade secrets, with no guarantee for his discretion; and, on the other hand, it would be practically out of the question for a man interested commercially in one establishment to expect to be allowed to examine into the details of others. In fact, an official position of some sort was almost necessary, as a guarantee to the smelter that the information afforded would not be used for private commercial purposes, and would be published with proper discretion. It was unreasonable to expect that, without these guarantees, the details of any business could be laid open to a stranger. As to the scientific knowledge and general ability necessary to complete such a work successfully, that would have been at any time forthcoming.

Consequently we may consider Dr. Percy's work as necessarily connected with his official position at the Government School of Mines; for although without that position he might have written a valuable work on Metallurgy, we doubt if he or any other man could have written such a volume as that now before us. Indeed, we should always bear in mind that the value of such an institution as the School of Mines is not to be measured merely by its educational results; for in maintaining a body of the most eminent scientific men in the country, devoted to the application of science to industry and the arts, we are certain to produce indirect results of almost incalculable importance.

We cannot pretend, in the space at our disposal this month, to attempt to discuss the distinctive features and opinions of this volume; we shall content ourselves, on this occasion, with giving a short summary of its contents.

As its title shows, this volume is devoted to Fuel and Fire-clays; and to the Metallurgy of Copper and Zinc, with their alloys, to which Dr. Percy limits his definition of Brass. But besides the usual introductory definitions on the properties of metals, and the principal metallurgical processes, it contains a very valuable prefatory notice on the composition and texture of slags, and the chemistry of the silicates.

Following this Introduction comes the division on Fuel, commencing with a preliminary discussion on the calorific power and calorific intensity of fuel in general. Wood, Peat and Coal (including Lignites) are successively discussed in detail; and then Charcoal and Coke—the latter at considerable length. The division on Fire-clays, and the natural refractory materials employed in the construction of crucibles, retorts, furnaces, &c., follows that on Fuel, and commences with a general enquiry into their nature and chemical composition, followed by details respecting the best known crucibles and fire-bricks.

* We are not unmindful of Mr. J. A. Phillips' work on Metallurgy, which has been of great service; but, excepting that portion treating of the metallurgy of lead, it did not profess to speak with the authority derived from personal inquiries.

Having completed these introductory divisions we come to Metallurgy proper, opening with Copper, which is the leading article in the volume. This Dr. Percy commences with a disquisition on the general chemical relations of that metal, and its resulting physical conditions; which will undoubtedly be found one of the most valuable practical portions of his book. Following this, is an Historical Notice on Copper Smelting in Great Britain, which cannot fail to be read with great interest: in our foregoing pages we have given one or two extracts from it. A short description of the various ores of copper brings us next to the Welsh process of Copper-smelting, naturally one of the most important articles in the volume. It is divided into three parts. The *first* is purely descriptive; the *second* is more theoretical, discussing as it does the reactions which occur during the process; and the *third*, which is of very peculiar interest, treats of the Elimination of certain Foreign Metals.

After the Welsh process, we have a short, but tolerably sharp, examination of various improvements in copper-smelting, including Napier's process, Rivot and Phillips's, and Mr. Hussey Vivian's. Next, a very full description of Copper-smelting in India, Japan, Sweden, Norway, various parts of Germany and Russia—concluding with an interesting notice of the Kernel-roasting process, at Agordo, in the Venetian Alps. Following this, we have another discussion of New Processes—this time on the wet methods of extracting copper, commencing with Bankart's and ending with Henderson's. *Apropos* to some of these (we suppose) Dr. Percy makes a few observations on the patent laws, with which, we think, men of business and men of the world will cordially sympathize. That the too easy facilities granted by these laws are now grossly abused by schemers and patent-mongers, is becoming every day more and more felt.

The succeeding question, the assay of copper ores by the Cornish method, is, as Dr. Percy says, "a tender subject with copper-smelters." That this method is not accurate is, of course, beyond all question; but that the miner suffers no real wrong is equally clearly shown: "in the present day the miner would not generally receive a farthing more for his ore whatever changes might be effected in the plan of assaying"—are Dr. Percy's words: yet he is of opinion that there would be a much better understanding between Miners and Copper-smelters if ores were assayed by a more accurate method. The division of copper-smelting is concluded with some valuable details and comparisons on the commercial aspects of the subject, and with notices on copper sheathing.

The division on Zinc commences with similar preliminary enquiries as in the case of Copper; and then describes, in succession, the English, Silesian, Belgian and Carinthian processes of extracting that metal; concluding with the methods of assay.

Brass, and the alloys of copper and zinc—yellow metals—occupy the concluding pages.

This volume has been long announced, and has excited proportionate expectations. Whatever these expectations may have been, Dr. Percy has more than fulfilled them, His work not merely conveys practical information of almost inestimable value, but it conveys it in a vigorous English style worthy of a colleague of Tyndall and Huxley. There is not a trace of obscurity or scientific circumlocution; nor is there, either, the least affectation of official reserve. Indeed, many may consider that in this respect it errs in an opposite direction—but to us this frankness is its most attractive feature. Dr. Percy, in the strength of his position, can afford to call "a spade a spade;" and he is not afraid to do so, or boldly to express opinions which men of smaller calibre would almost fear to insinuate. This may subject the work to attack from those to whose interest it runs counter, but it adds immensely to its value as a candid expression of opinion from a personally disinterested observer of undoubted authority. In discussing modern inventions, Dr. Percy has often had to approach very

tender ground; and it is in the nature of things that a man so completely versed in every branch of metallurgy, ancient and modern, should have a quick eye for the weak points in proposed new processes, and be apt generally to underrate their merit, which we think he is disposed to do.

The illustrations—152 in number—are all wood-cuts, and are models of accuracy and fine work. Indeed, almost the whole of them are miniature working-drawings.

Mr. Wallace on Mineral Deposits.

The Laws which regulate the Deposition of Lead Ore in Veins; illustrated by an Examination of the Geological Structure of the Mining Districts of Alston Moor. By WILLIAM WALLACE. London: Stanford, Charing Cross.

IN more respects than one this is a remarkable book. In the first place, it is remarkable from its substance; for although the leading idea may not be new, no one has ever before sought to work it out in the detail attempted by Mr. Wallace. It is also remarkable for its style, particularly when we are aware that the author is entirely a self-educated man, sprung from the working class, who had to earn his livelihood by labour from his childhood until he attained the position of trust he has for some time occupied. And lastly, it is remarkable for the excellent—indeed, we may say, luxurious—manner in which it is got up, and for the magnificent map and plates with which it is illustrated.

Mr. Wallace starts with the proposition, in which he fortifies himself with the authority of the evidence of Mr. John Taylor before the House of Commons Committee on the Mines Rating Bill, that although the art of mining probably gave birth to geology, the latter has done little or nothing in return for mining. To use Mr. Taylor's own words, "our knowledge is not greater than that of our forefathers; the difference is simply in improved machinery." Indeed, Mr. Wallace's impression of his own district is, that there has been rather a retrogression than otherwise. "Mining in Alston Moor is a more hazardous undertaking now than formerly. * * * * Practically, the art of mining has degenerated into a mere trial-all system." There are many besides Mr. Wallace who, if they spoke what they really thought, would bear testimony to a like degeneracy in metallic mining in other districts than Alston Moor, due almost entirely to the gambling spirit in which it is pursued. In the present day we have, of course, greater mechanical appliances, and, above all, greater capital; but it is very doubtful if the old miners did not far excel us in the true art of mining—that is, finding the maximum amount of ore with the minimum amount of labour.

The author is no friend to the school of "Where it is, There it is;" nor does he belive that

It is *only* by cutting the ground
That the metal is found.

"That the deposition of metallic substances in veins, is an exception to that law and order which regulate the succession of all natural phenomena properly understood, cannot for one moment be entertained by any one thoroughly convinced of the universality and uniformity of Nature's laws." Undoubtedly not; but yet it cannot be denied that the phenomena are in the highest degree complicated—so much so, that although they have been investigated to a certain degree by many competent inquirers, none have yet been able to find any leading clue. Still there is a great deal of difference between admitting our ignorance of laws which we are satisfied exist, and which we feel it our duty to seek persistently until we discover

and sitting down complacently in our ignorance. It is our duty to inquire unceasingly, and not to do so—and above all deliberately not to do so—is, as Mr. Wallace truly says, "disastrous to the interests of practical mining." It leads, naturally, to that sinful waste which we see monthly incurred in working concerns which, to use the words of our author, "would "be considered worthless after investigations based upon general laws, "even of an empirical character."

Such is the spirit in which Mr. Wallace entered upon his inquiries; and it is one in which every well-wisher of mining must heartily sympathise. How he set about them is best described in his own words:—

"Impressed with the importance of research and careful investigations in preventing an undue expenditure in mining works, about the latter part of the year 1847 I commenced copying numerous plans of the Alston Manor, and the adjacent ones, and resurveyed carefully the whole of the Nenthead district, both internally and externally. My principal object was, if possible, to find out some particular condition, or rather phenomenon, which as the cause of ore deposits invariably co-existed with them, and thus throw some light on the distribution of lead ore in veins. I need hardly inform the student of nature that these investigations proved a total failure. They convinced me, however, of the folly of pursuing such inquiries in the mazes of experience, without any theory or guiding principle of causation.

"A few years later, I had some reasons for concluding that increased responsibilities in connection with the Nenthead mines devolved upon me. I then began to investigate the matter still more carefully, and endeavoured to look upon the phenomena connected with the rich portion, and those connected with the poor portion of the same vein, as two distinct machines, each having separate functions to perform. What these were, was the problem attempted to be solved. Whether this is done correctly or not will remain for the scientific reader to determine. The subject, however, has cost me much labour and thought; and should I not succeed in unfolding a principle of causation, and that one the most important to mining interests, I may be allowed at least the credit of collecting and arranging a large number of facts illustrating some other principle *that is true*. It may, however, be observed, that the principle of causation, which the following pages, but more particularly those of the second book, are intended to unfold, has enabled me, in most instances, to anticipate the results of trials made in the Nenthead veins in the upper beds."

Mr. Wallace adopts the rather old-fashioned arrangement of separating his work into two Books. How he proposes dividing his subject between these, we will let him describe in his own words.

"This first book of this work will relate to the geology of the district, and the laws of the formation and direction of veins. It is not designed to instruct those deeply versed in the science of physical geology; but a far more numerous class engaged with practical mining. That portion which will be devoted to veins, may serve to dispel the common error, that veins may exist anywhere, and that no principle can be discovered to guide the miner in searching for them, or lessen the hazard of his expensive explorations.

"The second book will relate chiefly to the filling up of veins with lead ore. As the most natural arrangement I intend to follow the order and succession of ideas, as gradually unfolded in my own mind. I can hardly hope that the foundation of facts, on which the reasoning (as well as the construction of the accompanying map) will depend, is in all cases free from error. These must necessarily occur, in a first attempt of this kind; and can only be removed by the suggestions of those interested in the investigations. I have, however, taken much pains to ascertain their correctness, and not unfrequently has theory, which the facts are intended to support, led to further inquiry and the correction of the latter. To delay the publication of a work of this kind until perfected, would prevent its publication altogether."

The first two chapters of the First Book—one treating "Of the Laws which have regulated the Deposition of the Mountain Limestone in Great Britain," and the other "Of the Elevation of the Rocks of Alston Moor to the position they now occupy, and the Laws which have regulated the Denudation of the Country," are almost entirely devoted to subjects which more properly belong to general geology than that special portion which it

is Mr. Wallace's object to investigate. We think, therefore, that a very large portion of them might, with advantage, have been omitted. Indeed they can only be justified on the ground that the book is professedly written, not for "those deeply versed" in geology, but for practical miners; and it is possible that Mr. Wallace's special knowledge of this class convinced him that it would not be wise to assume that they were already acquainted with the elementary geological knowledge he recapitulates in these chapters. Still the necessity is to be regretted, for a succinct view of the special features of the geology of the district might have been given more clearly in a fifth of the space; and expatiations on the well-known general geological principles of deposition and denudation are apt to be found tedious in a treatise on the deposition of lead ore in veins. It must in fairness be stated, however, that if Mr. Wallace is given to wander a little too discursively, his geology is perfectly sound—he is thoroughly imbued with the modern Lyellian philosophy of that science.

Passing over these two chapters we come to those which treat "Of the Laws which regulate the Formation and Direction of Veins." The subject is really very ably discussed, and with considerable originality; and as far as we are able to judge, the conclusions arrived at are sound. Mr. Wallace's mode of investigating and reasoning are best shown by the following extract from the 3rd chapter, which treats of the formation of veins generally.

"It is remarkable that in no case do the streams of Alston Moor flow upon or in the line of the great cross veins; nor does it appear that the existence of the latter have ever influenced even the direction of the former. The bed of the Nent river in the upper part of its course is formed upon strata elevated considerably above the same beds on the east side of Carr's vein. Above the village of Nenthead, the Nent crosses Carr's vein at an acute angle, but its direction is not in the least degree altered; and between this vein and Foreshield Burn, the direction of this stream does not vary much from a direct course, which, as pointed out in the preceding chapter, nearly corresponds with the direction of the general dip of the strata.

"It will also be observed upon the map that no stream flows upon or in the direction of the great Sulphur vein. On the contrary, in that part of its course between Duffergil and Cashburn, its existence is marked on the surface by a series of low mounds consisting of quartz mineral. It does not appear that this powerful vein has ever modified the direction of even the smallest streams. The same remarks are applicable to the east and west veins. Browngill vein—the strongest east and west vein in Alston Moor—dislocates the strata at least 80 feet. Yet no indication of this vein is found upon the surface. The hills are rounded off without any apparent modification of their outline. Generally it is only where the streams have worn a channel in the solid rock that veins appear at the surface.

"Had these powerful veins been formed at the same time that the land emerged slowly from beneath the sea, and when the principal portion of the valleys was scooped out by denudatory forces, it is not easy to conceive otherwise than that the unequal elevation of the strata consequent upon their throws, would have modified the action of those forces so as to connect the direction of the veins with certain lines of least denudation. Such, however, is not the case; no matter how great the amount of displacement of the strata, the form and outline of the hills are seldom if ever affected by it. Two questions therefore arise:—Under what conditions were they formed and at what period, with relation to other geological changes which have affected the structure of the district?"

Mr. Wallace, for the purpose of his investigation, divides the veins of the district into three distinct kinds:—

1st class, east and west veins, with a direction varying between N. 60 E. and S. 60 E. magnetic, which are generally well mineralised, and contain metallic substances when their sides are formed of any hard strata of limestone and sandstone.

2nd class, cross or north and south veins, varying less in direction than the former, and rarely containing any metallic substances (or, indeed, any vein mineral) in strata above the Great Limestone. These veins have

produced much lead ore in the Great Limestone, and both lead and copper below.

3rd class, quarter-point veins; a class of small veins, intersecting both the others, and traversing the country in two directions—one S. 55 E., and the other S. 55 W., magnetic. In the strata above the Great Limestone they contain little vein minerals, but in the strata below seemed to be filled with copper and iron pyrites.

Besides these three classes, there is another vein, the Great Sulphur Vein (sometimes attaining a width of 300 feet) which is classed *sui generis*.

In chapters four, five and six, Mr. Wallace discusses in detail the conditions of these veins, as evidencing their positive geological age, as well as their relative age between themselves, which, in our opinion, is the most successful portion of his labours. We shall allow him to describe his conclusions in his own words as to the east and west veins:—

"I trust we have satisfactorily shown that the formation and direction of the east and west veins are connected in causation with the formation of this axis (the elevatory axis of Alston Moor)—are, in fact, correlated phenomena, consequently the veins must have been in existence before the removal by denudation of the rocks which once filled up the valleys, on which we may base the hypothesis of the formation of the east and west veins having taken place before the removal of the coal measures by the currents of the sea, or by breaker action, and which enable us to conclude, with great probability, that the east and west veins were in existence when the strata were lying at a depth of at least 5,000 feet below the highest point of their present elevation."

As to the north and south, or cross, veins:

"Notwithstanding in all the instances we have adduced, the cross veins are *apparently* the intersecting and the east and west veins the intersected ones—the facts pointed out are sufficient to establish the following proposition, namely, *the cross veins in the mining district of Alston Moor were formed either anterior to or contemporaneously with the veins which traverse the district in an east and west direction.*"

As to the quarter-point veins:

"I am led to suppose that the quarter-point veins were formed posterior to the cross veins, and either contemporaneously with or anterior to those of the east and west veins. With respect to this alternative, it may be observed that the relation of veins to each other, with reference to their period of formation, can only be safely determined by careful observations of their connection with the inclination and position of the strata. It is only in the upper part of this district that I have had opportunities of studying this connection where, as observed, the veins are comparatively weak. In consequence of which I have not been able to arrive at a more definite conclusion."

This brings the First Book to a close. As Mr. Wallace concisely sums up its conclusions, theoretical and practical, in what he calls a few "concluding aphorisms," we probably cannot do better than quote them here:

"1. The strata were originally thrown down in nearly a horizontal position. This could only be effected by an equal subsidence of sea bottom throughout wide areas, and that during the whole period occupied in the deposition of the old red sandstone, mountain limestone, and coal measures.

"2. That at the close of this period, and before the Permian rocks were deposited, this vast thickness of rocks was thrown out of its horizontal position by forces of subsidence or elevation, probably the latter, and the cross veins formed, these being simply fractures parallel to lines of greatest effect produced.

"3. Afterwards the great axis of elevation, which commences at Cross Fell and extends eastward, was formed, and with it a series of east and west veins, the formation and direction of which evidently depend upon the tension the strata were subjected to by unequal elevation and the irregular bendings of this line of greatest intensity of force, as indicated by its effects. When this took place the Coal Measures had not been removed from the Millstone Grit.

"4. The denudation of the Coal Measures now took place, and also the formation of the Permian rocks, the action of the denudatory forces being regulated by the lines of greatest elevation of the rocks, the Coal Measures being entirely swept from off broad areas of country."

We now come to the Second Book, which Mr. Wallace evidently believes to embody a new philosophy. We cannot say that we quite take this view; for while we cordially admit the great value of all the facts brought forward, as well as many of the conclusions, we do not agree in considering him to succeed in at all proving his main propositions. That they represent the rudiments of some general laws which may hereafter be worked out, may be admitted; but that Mr. Wallace has succeeded in elucidating these laws we feel obliged to dispute. As valuable suggestions—as "guesses at truth"—as highly probable speculations, we are willing to receive the author's conclusions, but must enter a *caveat* against their being taken as scientifically proven.

The following extract will best show the leading idea, often indicated rather than expressed, that runs all through the author's reasoning:—

"Two theories have been proposed to assign the source from which the ore has been derived or its elements have been supplied: the one supposes it to be a segregation from the enclosing rocks, the other a sublimation from great depths and connected with volcanic influences.

"It is necessary to observe, that the laws which have regulated the distribution of the ore in the veins may be of a different character from those connected with its origination: the former may be mechanical, the latter, if the metals are substances compounded from certain elements unknown in a separate state, must be chemical. If, however, they are simple substances, which have risen to the surface as gaseous emanations from the interior of the earth, then the distribution or accumulation of the ore into certain portions of the veins may have taken place after its deposition sparsely throughout the whole extent of the fractures in the rocks. If they are derived from rocks in which their existence cannot be detected, then the compounding and localization of the ore may have been contemporaneously effected.

"If metals are compound substances, as some of the most able and ingenious chemists have supposed, then a knowledge of the process or processes by which nature has manufactured such large quantities of valuable metals would be exceedingly interesting, even in a scientific point of view alone, though it seems improbable that its use would be altogether restricted to chemical experiments or to abstract speculations, and that it should not in some form or other ultimately prove practically beneficial to the interests of man: but were we in possession of this knowledge, and had the requisite skill to produce such substances so essential to civilized life, it is questionable whether we could do so economically; it is not improbable but that we should be under the necessity of searching for them as at present by mining operations. Should this be the case, a knowledge of the laws which have regulated the distribution of the ores in the veins would even prove more valuable to the practical wants of man than the knowledge of the laws of their combination from *elements*, whether these are derived by sublimation from beneath or segregation from the rocks."

There is nothing very novel in these speculations, which, as speculations of possible contingencies, it is probably well to bear in mind. But to advance beyond this, and assume them as most probably true, and to evolve an hypothesis founded mainly on such an assumption, is travelling beyond the limits which modern science allows to theorists. There is no evidence whatever that the metallic contents of veins can be derived from their containing strata; indeed, the evidence is so much the other way—as far as our knowledge of the composition of rocks at present goes—that those who are most impressed with such a notion are driven to the speculation (which has taken such root in Mr. Wallace's mind) that many of the metals after all cannot be elements. It may of course be true; but tacitly to assume it, as is done in the beginning of the following extract, which we have printed in italics, is not justifiable:—

"*Assuming, therefore, as the more probable view of the case, that the deposition of lead ore in the veins of Alston Moor is due to segregation from, or decomposition of the rocks which form the walls of the veins where such deposits are found*, then the regulating causes must be sought for in the phenomena connected with the rich portions of the veins and enclosing rocks, and equally so in the phenomena connected with the unproductive portions. The former should be carefully studied, in order to discover, if possible, the functions they are adapted

to perform, or the natural forces they would call into action as effecting the deposition of lead ore; the latter, in order to discover their inadaptation to produce the same results."

Starting with these preconceived ideas, Mr. Wallace proceeds in Chapter 2 with his inquiry by examining the conditions connected with the productiveness and non-productiveness of the Rampgill vein, which seems to have varied very widely in different parts. We cannot follow him into the details of this inquiry, which results, however, in the following conclusion, which we again give in the author's own words:—

"We are now in a position to affirm, that the conditions connected with the very rich portion of Rampgill vein, in the Great Limestone, differ from those connected with the portion which has been very poor in this most *important particular;* that they would promote a *free* circulation of water or fluids in a longitudinal direction, *to* and likewise *in* the vein. We have already observed that the variation in amount of lead ore in the same vein and in the same stratum is greater than that of any other mineral found in veins. *The assumption is therefore warrantable, that such a variation is due in all cases to certain laws regulating the circulation of fluids, the effect of such circulation being modified by various conditions.*"

The concluding portion of the above extract, which we have printed in italics, embodies the principal hypothesis which this work is written to establish, and upon which we have already expressed our candid opinions. In chapters 3, 4 and 5, Mr. Wallace investigates (1) the laws which regulate the descent and movement of water beneath the surface; (2) the action of this water in effecting the decomposition of the rocks forming the sides of veins; and (3) its action in effecting the depositions in these veins of certain vein-minerals, such as carbonate of lime, barytes, &c. These chapters are very well done, and contain a considerable amount of interesting information, but they present no particular novelties. We are rather surprised to find that the author seems to have no acquaintance with the writings of Bischof, the great expositor of the doctrines of subterranean aqueous chemical action. Mr. Wallace quotes, often very copiously, Lucretius, the *Novum Organum* (in the original Latin), Oersted, Whewell, Cicero, Baden Powell (Unity of Worlds), John Stuart Mill, Wordsworth, Sir Thomas Browne, Thomson's "Seasons," Humboldt, Sir Humphrey Davy, Dr. Mantell, Pliny (in the original), Hugh Miller, Dr. Daubeny, Spencer's "Faerie Queen," Bacon's Essays, and other curious books—evidencing a considerable mental cultivation and a wide range of reading; but with that one author whom above all others he should have thoroughly studied, he seems to be wholly unacquainted.

In the next five chapters (6, 7, 8, 9 and 10), Mr. Wallace traces the connection between the laws of hydrous agency he has laid down, and the deposition of lead ore in the veins of the districts he treats of. That he makes out a fair case of a certain connection between deposits of lead ore and a free circulation of water in the veins we are willing to admit, but that he succeeds in establishing any general law of correlation we must deny. We have had ample evidence of the danger of pushing local experience into general hypotheses in the case of metalliferous veins; and we must guard against this in Mr. Wallace's case, particularly as there seem, on his own showing, to be exceptions to his laws, which can only be accounted for by assuming what we have already shown we are not justified in assuming. As will appear from those portions of the following extract which are printed in italics, the veins in certain lower beds are poor, although the facilities for the circulation of water are even "more favourable" than in those beds where the veins are rich. The assumptions (also printed in italics) by which this discrepancy is attempted to be met cannot be received without proof.

"From this inquiry into the conditions connected with lead ore deposits in veins traversing the lower beds, nothing has arisen to support the theory of sublimation of metallic particles from great depths, and their subsequent cumulation in patches by hydrous agency. *The conditions for promoting the percolation and circulation*

of fluids connected with some portion of the veins traversing the lower beds," (where they are poor) "*are in a few instances even more favourable than those connected with any of the veins in the upper beds*" (where they are rich). "*Yet how very different is the result in each case, notwithstanding the similarity of the circumstances and conditions. * * * * By the theory of lead, or of some lead ore producing substance, entering into the composition of rocks in varied proportions, variations in the amount of lead ore contained in veins under the same conditions are easily accounted for.* The decomposition of the limestone and sandstone rocks by fluids circulating in them near the surface may be effected to as great an extent in the lower as in the upper strata: *but in the latter case it may be that a less quantity of some unknown substance is set free to enter into those combinations necessary to form lead ore. * * * **

"From the enquiry respecting the lead ore deposits in the veins of Alston Moor, now brought to a close, it would appear that either lead in connexion with some *basifying principle* (sic) must enter, in varying proportions, as a component part of the rocks of this district, or *some still more elementary substances from which it is formed by laws of chemical combination as yet unknown.*

"I am not aware that the limestones and sandstones of Alston Moor have ever been subjected to careful chemical investigations. Should the most searching investigations fail to discover lead in the rocks, in this case I should feel inclined to adopt the other hypothesis, *that this metal is formed from still more elementary substances as yet unknown in a separate state*, but set free by the decomposition of the rocks, and held in solution by the circulating waters. As yet chemists have not been able to analyze pure metallic substances into simpler elements, but we are assured in the history of chemistry, and by the opinions of some of the best thinkers and experimentalists, that their supposed elementary character is "a mere passing idea." *Should this hypothesis be correct then the comparative non-productive character of the veins in the lower beds would be due to the small quantity of these substances entering into the composition* of both limestone and sandstone rocks."

That the great number of facts stated by Mr. Wallace form a most valuable addition to our knowledge of the conditions attending the lead veins of the North of England is not to be doubted; several of them are quite new, and they are all evidently stated with the most conscientious accuracy. Many of his conclusions also—for instance those with regard to the causes under which the veins originated, and their absolute geological ages—are equally valuable, and show that he has not in vain studied the great father of inductive philosophy. But in the principal theory which he seeks to establish—which is indeed the main drift of his book—we think there lurks a *petitio principii*, scarcely such as we should have expected from one who so familiarly quotes Mill's "Logic." Mr. Wallace conceives that the lead ore was deposited by water; and a careful examination shows that the conditions favour such a view. Many have before maintained this hypothesis, although none have hitherto worked it out so carefully; and so far Mr. Wallace is entitled to a greater amount of credit. But the primary difficulty—as to *whence* the metallic ores are derived—which previous enquirers have felt so great as to have considered progress hopeless until some clue is found to it, is still left unsolved; or we should rather say, is *de facto* assumed. Mr. Wallace takes for granted that, in some form or other, the lead existed in the rocks, whence it was taken and deposited in the veins by aqueous agency. In our opinion this is cutting the Gordian knot rather than untying it. In all theories of metalliferous veins, the first point is to decide the source of the exceptional abundance of metallic contents which characterize them; this is the major portion of the proposition, which it is not permissible for us to assume, without begging the whole question. No one considers it necessary to enter into lengthened disquisitions on the origin of calc-spar veins in limestone strata, or of quartz veins in rocks made up chiefly of silicated minerals; they are admittedly derived from the rocks which contain them, and with this admission all difficulty disappears.

Wallace objects to the hypothesis that the metals are derived from ·, and in the case of the lead deposits of the mountain limestone his

objections seem to be well-founded. But attempting to prove an hypothesis by elimination—by showing that another hypothesis is still more improbable—is not science. Hundreds of enquirers into the phenomena of metalliferous deposits have wished to persuade themselves that they were justified in assuming the metallic contents of veins to be derived from their containing rocks; but, in the absence of any evidence, none have hitherto felt warranted in taking such an hypothesis for granted.

We have spoken candidly of this work, of its many merits and its weak points, for it forms no part of our intention to allow our notices of books to degenerate into mere indiscriminate laudations. It is much to be regretted that before publishing his speculations in the form of a book, Mr. Wallace did not bring them before some of the London scientific societies. In these assemblies—little parliaments of science—new hypotheses are certain to meet with a thorough sifting, and it is only after having gone through such an ordeal that even the most eminent men venture to put hazardous speculations into the more enduring form of a thick octavo. The theoretical weakness of some portions of Mr. Wallace's book militates, however, but very slightly against its general value. Taken altogether, with its magnificent maps and sections, it will long be referred to as a textbook of the Alston Moor district, and as a reliable repertory of facts connected with the conditions of the formation of lead ore in limestone districts.

Bristow's Glossary of Mineralogy.

A Glossary of Mineralogy. By Henry William Bristow, F.G.S., of the Geological Survey of Great Britain. London: Longmans.

Mineralogy has not, in modern years, been very popular in England. This has been attributed by many to the excessive pedantry and technicalities in which writers on the science have loved to indulge—and which some years ago was the subject of a sharp rebuke from Professor Sedgwick. Indeed, of all those branches of natural science which mainly depend upon a classification of species, there can be little doubt that, for a considerable time, mineralogy has been investigated on a comparatively narrow and pedantic system; a system which delighted in multiplying species as much as possible by dwelling upon, and often exaggerating, the minutest differences. That a science pursued in this spirit—particularly when coupled with notions of the unchangeableness of species borrowed from the dogmas of biological science—should have been repulsive to men of larger views, caring little for a pursuit whose whole end and aim seemed to be the measuring of angles, is not surprising. Recently, however, mineralogy, like other branches of natural science, has been pursued in a wider spirit, and abler enquirers have taught us that its main object should be to bring allied species together—to trace their similitudes and transitions—rather than to isolate them by barriers, often imaginary. Under this new principle of prosecuting mineralogical researches, the science, hitherto so barren and repulsive, has, to adopt the idea of the greatest mineralogical writer in the English tongue, become a living thing. The mineral kingdom, instead of being put before us as consisting of so many hundred disconnected species, each isolated from the other by impassable barriers, is now presented as a whole—as a regular series of mutable species passing insensibly into each other from one pole of the mineral kingdom to the other. Pursued in this spirit, mineralogy becomes one of the most interesting—indeed we may say fascinating—branches of natural philosophy, and one of the very highest importance in elucidating many of the greatest geological problems yet unsolved.

In making these observations we have, of course, no intention of speaking disparagingly of an accurate knowledge of crystallography, which must be the basis of all sound mineralogical knowledge. We only object to mistaking the *means* for the *end*, as seems to have been done by a class of enquirers whom we might best describe as "cabinet" mineralogists, whose object has been to isolate species and regard them without reference to each other; while the object of the geological and chemical mineralogist should be to regard them in their relations and associations—or their *paragenesis*, to use the word employed by the Germans.

Besides the great work of Dana, there are two other highly popular English mineralogical works—Philips's Mineralogy, edited by Brooke and Miller; and Nicoll's Manual of Mineralogy. The former is a work of great authority, Professor Miller being undoubtedly the most eminent English mineralogist; but neither the systems of classification nor crystallography have met with as much favour as those adopted by Professor Nicoll, whose manual is now out of print, and which must not be confounded with a more recent work of his on the same subject—a reprint, we believe, from the last edition of the *Encyclopædia Britannica.* But there has been hitherto no work in English at all answering to this "Glossary" of Mr. Bristow. It is a Dictionary of Mineralogy of the most complete kind, and yet in the most portable form, and must become a *sine quâ non* to every practical mineralogist. Unincumbered with any system of classification, it describes every mineral species or variety alphabetically, with cross references to synonymes, English, French and German.

The description of the minerals is at once concise, and yet sufficient for practical purposes. It includes their crystalline and physical characteristics, chemical composition (shown both by formula and analyses), behaviour before the blowpipe, and their principal localities and uses. It need scarcely be said that Mr. Bristow having the resources of the Jermyn Street Museum at his hand, as well as the assistance of so eminent a mineralogist as Mr. Warington Smyth, has had great opportunities of turning out a good book. And he has certainly done so. We can only find one fault, which is the formula he adopts for silicic acid, $Si\ O^3$. We think that this is a mistake, particularly so in a work on mineralogy, as recent enquiries give us reason to suppose that this acid is isomorphous with other compounds of the form $R\ O^2$. The benefit of keeping to the old formula is very slight, particularly now that it is renounced by Rammelsberg, who has adopted the formula $Si\ O^2$ in his new *Handbuch der Mineralchemie.*

Notwithstanding the great body of information it contains, this little volume has the advantages of extreme clearness of type and great portability. For tourists and practical men interested in mineralogy it will be indispensable; among the former we expect Mr. Bristow's green book will be seen often side by side with Mr. Murray's red volumes.

The Government School of Mines, and the Museum of Practical Geology.

THE Students' Lectures at the School of Mines will be resumed on the 6th of January; when Dr. Hofmann will commence a course of thirty lectures on "Organic Chemistry."

Mr. Warington Smyth will also continue his course of lectures on "Mining." In that portion of his course already delivered Mr. Smyth has discussed the conditions connected with the deposition of the useful minerals, and the laws regulating their occurrence, as far as our knowledge [illegible] examined their accidents, dislocations, and the points to be observed

in searching after them; and described the modes of boring for and excavating them, and the tools employed. In the lectures yet to be delivered, Mr. Smyth will discuss the modes of sinking shafts, driving levels, &c., and the various methods of securing them: describe the usual methods of working away mineral deposits, transporting the produce underground, and drawing it to the surface; as well as the most approved arrangements of draining and ventilating mines.

Mr. Smyth will also continue his course on "Mineralogy," which however is drawing to a close.

Dr. Percy will likewise resume his course of lectures on "Metallurgy." In continuation of those already delivered, he will proceed with a special description of the processes connected with the treatment of argentiferous copper, silver and gold ores, with the alloys of these metals, and the modes of assaying them. Following these, the Doctor will treat of the metallurgy of mercury, antimony and its alloys, bismuth, nickel, cobalt—including the manufacture of cobalt colours. Next of arsenic and arsenious acid, and the smelting of the ores of tin. The last section will be on the making and manufacture of iron and steel.

Professor Huxley's course of "Natural History," now about half completed, will also be continued.

Early in February two other courses will be commenced—one of thirty lectures, on "Geology," by Professor Ramsay; and another of about thirty-six lectures, by Professor Willis' on "Applied Mechanics."

In addition to these students' lectures, two courses of evening lectures, for working men, will be delivered during the month: one by Dr. Hofmann on the "First Principles of Chemistry;" and another by Mr. Geikie, who temporarily supplies the place of Professor Ramsay, on "Geology." These lectures are of great value as a means of disseminating sound scientific knowledge among the body of the people, by whom the opportunity is fully appreciated. Mr. Geikie's course, which will comprise a condensed description of the geological formations of the British Isles, we strongly recommend to the attention of our readers, residing or sojourning in London, who come within the definition of "working men."

The Geological Survey of the United Kingdom.

Of all the labours of the survey, none are more important than those pursued of late in the Midland, Lancashire and Scotch coal fields, which have resulted in memoirs on the Warwickshire, Lancashire, and Edinburghshire districts, recently issued, the importance of which, in an economic point of view, it is really difficult to estimate too highly, particularly those laid down on the 6-inch scale. In addition to the eight 6-inch maps already published, a new vertical section is now ready, on a scale of 40 feet to an inch, illustrating the position, mineral character, and thickness of each bed of the Permian and Carboniferous strata, as they are met with in South and West Lancashire districts. The system recently adopted of issuing a descriptive memoir with each new map, in which various information of great value is given, and the geologist is pointed out where the best fossil localities, the best exposed sections, &c., may be found, much enhances the value of the maps.

Among the other new publications of the survey are the following:— A Memoir on the Geology of the Isle of Wight, by Mr. Bristow, containing a list of fossils, by Mr. Etheridge; and Notes on the Eocene Flora of Alum Bay by P. de la Harpe and Mr. Salter. This memoir describes all the formations in the island, in addition to those already treated on in the late Professor Forbes' memoir, which was confined to the Tertiary Fluvio-

marine deposits. The list of fossils is most complete, and numerous illustrations are given of the characteristic forms of such stratum.

A memoir descriptive of map 12 (parts of Berkshire and Hampshire) by Mr. Bristow and Mr. Whitaker, containing a list of fossils by Mr. Etheridge, is also ready. Likewise, a new decade (No. 10) giving a description of the Fishes of the Devonian Epoch, by Sir P. de Malpas Grey Egerton, with a preliminary essay on their systematic arrangement by Professor Huxley, in which the whole question of the classification of the Devonian Fishes is considered, "and results arrived at which seem to necessitate an important modification of the received arrangement of the great order of *Ganoidei*."

The "Iron Ores of Great Britain," part 3, contains a general description of the iron ores of South Wales, classified as follows:—

1. Clay iron-stones found in coal measures.
2. Iron ores of the carboniferous limestone.
3. Iron ores of the Permian series.

This we shall refer to more fully on another occasion.

Mining, Quarrying, and Metallurgical Intelligence.

CORNWALL AND DEVON.

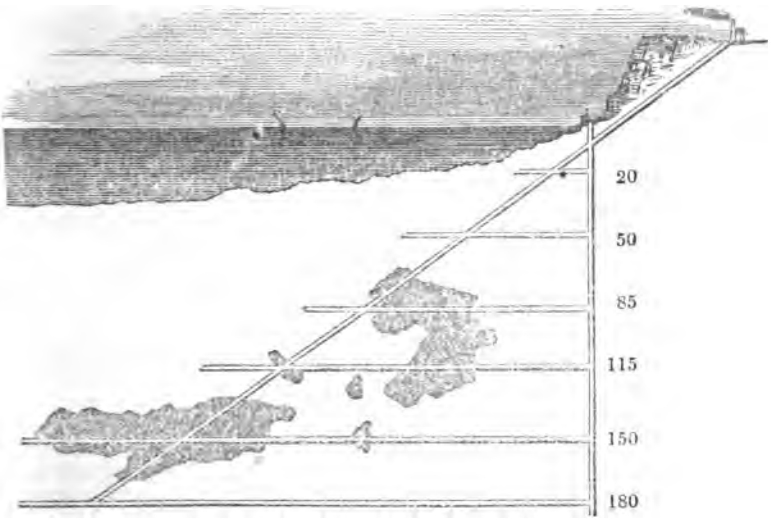
St. Just District.—Notwithstanding the just celebrity and great productiveness of this, probably the most ancient mining district in the world, it is a matter of fact that there are only two mines in it at present paying dividends—and those not large ones. This, at first sight, may appear a very unpromising state of things, and might induce many to believe that the district had retrograded from its ancient fame; but a closer examination shows this not to be the case, for we find that the old-established and hitherto well-paying mines have suspended dividends, not from dire necessity caused by exhaustion and poverty, but from the desirability of making large expenditure on new works required by the altered modes of modern mining. Thus, in every direction we see new works going on: new shafts sinking; new pit-work being put in; new stamping and winding engines being erected; all which, although dead work at present, will produce their harvest in good time. The mines paying dividends now are:

Wheal Owles, one of the few mines remaining of the thorough old Cornish stamp, divided only into 80 shares, not one of which has changed hands for years. This mine was long under the management of the late Mr. John Boyns, better known in St. Just as "Purser Boyns;" a most worthy and excellent man, and a fine specimen of the legitimate Cornish miner of that "olden time"—now almost a thing of the past—when Cornish men worked their own mines, and consequently worked them fairly and honestly. He has a worthy successor in his nephew, the present purser, Mr. Richard Boyns. Wheal Owles is not a rich mine, but it is well worked and cautiously managed. The produce is principally tin, which is of very fine quality. At the last account the dividend was £400. *Boscean* divided £240 at the last account. The floors at this mine are now very compact, a new water-wheel, and twelve heads of stamps, having been recently erected, as well as a new tramway laid down.

Among the mines not paying dividends, the most important is *Botallack*. Few of our readers can be unacquainted with this fine old mine—one of the great sights of Cornwall—worked out under the sea for nearly the third of a mile: every one who has "done" West Cornwall, or even read about it, must remember Botallack, with its high precipices, and its engine-houses and machinery perched upon ledges of rock and washed by the storms of the Atlantic.

. This mine is worked under the sea at two points—at Wheal Cock and at Crowns. The accompanying sketch, fig. 1, is a rough section of the latter

FIG. 1.



SCALE 50 fathoms to one inch.

mine, showing the position of the workings under the sea on the Crowns lode, and the new diagonal shaft which, after a labour of four years, is now nearly completed.

Those who have visited Botallack may remember standing on the cliff at this part of the mine, and looking down, a distance of 250 feet, upon an engine perched upon a ledge of rock employed in winding from a shaft some little distance below that again. The shaft is called Pearce's whim shaft, and is the one shown in the section: to get to it you had to descend a winding path cut in the cliff, called the "Mules' path," from having been originally made for the use of mules, to carry up the ore from the shaft to the dressing-floors above. This whim shaft has been sunk to a depth of 180 fathoms; but at every succeeding level, longer and longer drivings had to be extended from the shaft seaward, through unproductive ground, in order to reach the orey part of the lode, which dips away from the land, as will be seen by the section, where the orey parts are shown in shading. Thus at the 150-fathom level, upwards of 200 fathoms of dead ground had to be gone through; and at the 180-fathom level, 260 fathoms of dead ground. To pursue the shoot of ore further, under such circumstances, became impossible. In a mine working under ordinary circumstances the difficulty could have been met by sinking a new shaft down upon the orey ground; but as it was not possible to sink a shaft in the Atlantic Ocean, this resource was closed to Botallack. The lode was not to be readily abandoned, for it was a very rich one, having in one year, between the 85 and 115, yielded £24,000; and the ground above the 150 having yielded £50,000. At last it was determined to sink a new diagonal shaft from the surface, at such an angle that it should cut the productive part of the lode in the bottom levels. As shown in the section this has now been accomplished, the shaft having been sunk 345 fathoms, cutting the 180-fathom level at a distance of 260 fathoms from Pearce's shaft. As the Crowns lode is enclosed in hard greenstone rock, it was found impracticable—except at an enormous cost—

to make the shaft larger than 6 feet square. This is, of course, a very small size for a shaft, and precludes the possibility of having more than a single wagon-way: the wagon used will hold about 16 cwt.

Winding from Pearce's shaft is now discontinued; and as the boilers from thence are to be used for the engine erected at the head of the new diagonal shaft on the top of the cliff, the operation of moving them took place a few weeks ago. This was a matter of no small difficulty, as they had to be drawn up over a cliff of about 40 fathoms in perpendicular height: one of the boilers (of 9 tons) was lowered there twenty years ago, and the other (of 10 tons) was built in its place. To raise these, an inclined roadway of balks of timber was laid down (supported by cross-pieces and uprights from the face of the cliff) 70 fathoms in length. At the top of this two hand capstans and two winches were fixed. Chains were firmly secured at top, carried down the incline, passed round the boiler to be raised, and then fixed to the capstans.

By these means the boilers were fairly *rolled up* in the most successful manner, without any mishap whatever. The work of fixing them in their new position is being actively proceeded with, and in the course of a short time winding will be commenced at the new shaft.

Besides the sinking of this new diagonal shaft on the Crown's lode, which is the copper portion of the mine, great improvements have also been made in the tin dressing departments. A steam-stamps of 32 heads has been erected, and very excellent floors have been laid out with all modern improvements—including several of the German rotating frames. But little debt now remains on the mine; and as its position will in every respect be improved, and its returns increased, we may expect to see it shortly again resume dividends. The energy and economy with which the new works have been carried out at this mine reflect great credit on the management of the purser, Mr. Stephen Harvey James, of St. Just.

Levant, another mine worked under the sea, and which was formerly very productive and profitable, has lately, like Botallack, been spending large sums on new machinery necessary to keep pace with the times. This was one of the first mines in the district to adopt modern appliances, and its example in this respect has been very useful: several rotating frames have also been erected here.

Balleswidden, a great old mine, has also for a long time been laying out money. A new 80-inch engine is now being erected, and new pit-work put in. When this is completed the mine will be in a position to be worked vigorously, by sinking deeper and opening out new ground.

At *Boscaswell* the work now carried on consists in clearing old levels and driving up a deep sea adit. In former workings this mine made large returns, and the present party have made considerable sales from the waste heaps of their predecessors, which has helped them considerably in erecting their new machinery.

Bosorn and Bollowall United—two old mines united and worked as one. As yet no machinery has been erected, and the operations are confined to clearing up old levels. The sett contains numerous lodes, from some of which good stones of ore have been broken in the bottoms.

Bosweddan and Wheal Castle is very peculiarly situated in a narrow valley, where the sides rise so steep on either side that there is scarcely any level ground on which to build; so that, for buildings and floors, the ground had to be cut away and "made" at great expense. Good machinery is now erected; and a new incline shaft completed to explore the portion of their lodes running under the sea. At the last account, a call of £800 was made.

At *Carnyorth* and *Spearne Consols*, which were formerly worked together but are now separated, the operations are confined to explorations. *Spearne Moor* is looking better.

Pendeen Consols, in the northern part of St. Just, is a mine which has justly attracted a great deal of attention. It has been opened out in a vigorous and workman-like manner; but the operations seaward have been for some time suspended, pending arrangements between the lords of the soil, the duchy and the crown, as to their respective rights to the minerals found under the sea. These being now settled, we may expect to see the levels resumed diving seaward, where there is every prospect of good results.

MARAZION DISTRICT.—The only mines in this district at present presenting any features worthy of special notice are *Wheal Grylls* and *Prosper United*. In the former a valuable bunch of tin—of the nature of a "carbona"—has been discovered above an old adit level, from which considerable returns have been made. A stamping engine is now being erected, which may be expected to be at work early in the year, and from which a flat rod will be connected to follow down this rich shoot of tin. If it should continue for any depth as it has been above adit, fine returns may be expected in a short period. The value to tin sold in the stone last month was £722.

Prosper United was brought before the public about eighteen months ago, and found such favour with them that the shares went to £1 per share premium, or £6,000. That the mine is an excellent speculation is undoubted, but that it was worth paying at the rate of £6,000 for the privilege of partaking in it is not by any means so clear. Taken in connection with the reaction which followed, it is a remarkable instance—and one worthy of noting—of the unreasoning and impulsive spirit with which a certain class of mine speculators seem to be animated, which induces them to run after things at prices evidently far above their real value, and then (like a child with a toy) rush panic stricken to realize at a price equally below their value. A heavy concern like Prosper United, requiring immediately five steam engines—including two 70's—was, on the face of it, a speculation requiring large expenditure, and which could not possibly be brought into working order under a couple or three years. Yet the very same speculators, who a few months before had given £6,000 for the privilege of taking part in the enterprise, rushed to sell, and knocked down the shares to a nominal price. Nothing, of course, had occurred in the mine to justify this, because the engines were not half up: the circumstances were precisely the same when the public eagerly scrambled to give £6,000 for a concern upon which not a single shilling had been spent, and rushed (equally eagerly) to sell the same at the rate of £2,000 or £3,000 when £12,000 or £15,000 had been spent upon it, and when it had really gone some way towards becoming a property. And yet people who act like this are surprised that they lose money by mining!

Since this panic a discovery has been made in one of the shallow levels which has restored the shares to something like their intrinsic value. This is very fortunate, for no one can tell what might have happened under the effect of a long continuance of the panic-spirit: the necessary capital to complete the opening of the mine might not have been forthcoming, and the whole concern might have ended in a wanton waste of £15,000 or £20,000. Happily this danger is now a thing of the past, and we may expect to see the mine become, under the able management of Captain Thomas Richards, largely productive, and, it is to be hoped, profitable to the adventurers.

REDRUTH DISTRICT.—This district, which for a lengthened period has not been the scene of many new improvements, and which indeed has been now for some time living on its old discoveries, has been looking up lately. *East Carn Brea, South Carn Brea* and *North Downs* have deservedly attracted a great deal of attention within the last few months, and the former now shows every indication of becoming a great mine. It lies close to the town of Redruth—a little to the south-west—and is worked on a run

of lodes which may be considered a continuation of those wrought in the eastern part of Carn Brea Sett: it lies in nearly the same parallel as Wheal Buller and the Tolguses. On the opposite page we give three sections of the mine, which will help to make a description more intelligible. Fig. 2, a transverse section, shows the engine-shaft sunk on a lode called the "Engine lode," and now down nearly another lift below the 50—with levels at the 26, 40 and 50. Besides this engine lode, three other lodes are shown, one to the north, and two to the south.

Of these lodes, the main one—indeed the only one of much importance—is the southernmost, marked "South lode" in fig. 2. This lode has been intersected by cross-cuts from the engine-shaft at the depths of 26, 40 and 50 fathoms, at which depths levels have been extended east and west, as shown in fig. 3, which is a longitudinal section on this lode. In the 26 east from the engine-shaft the end has lately passed through a large cross-course, 5 or 6 feet wide, crossing the lode at an angle of about 45°. Just at the point of intersection this cross-course naturally disturbed and impoverished the lode; but about 6 fathoms west of it, a fine course of ore worth £60 per fathom for a short distance was passed through, and east of this, close up to the cross-course, the lode was worth from £15 to £20 per fathom. East of the cross-course the lode has again recovered all its former productiveness, the end being now reported worth £60 per fathom. It is important to observe that another cross-course is reported to exist about 40 fathoms again east of that shown in the section; and those who favour the mine anticipate—and not unjustly—that a course of ore may be found to extend from cross-course to cross-course.

The discoveries made in the lower levels on this south lode are equally satisfactory. Valuable ore ground has been opened out at the 40 and 50, which is shown in the section by *dotted* spaces, the shaded part showing the ground that has been taken away. Since the figure has been cut a good lode of ore has been met with in the 50, that level west being now reported at £25 per fathom, and the 50 east at £20. The 40 has also passed through a fine run of orey ground, and that level east being now valued at £45 per fathom.

The engine lode has hitherto been small and poor. The middle lode, of which a section is given in Fig. 4, has made a run of orey ground about the engine shaft, never rich, but just productive enough to come away on tribute, being worth from £6 to £10 per fathom. Besides these three lodes, others are known to exist to the north; one of which, shown in Fig. 2, may be expected to be cut very shortly. If this should turn out productive, it is needless to say how important it would be to the mine.

As no ore has been taken away below the 26, large reserves have been already accumulated, which so far from being trenched upon by the present returns of 250 or 300 tons per two months, are unquestionably at present accumulating, so that the returns may shortly be increased and fine profits realised.

East Carn Brea was started about 4 years ago by Mr. Joseph Lyle, of Bonithon, and about £20,000 has been spent in bringing the mine to its present desirable position. Mr. Lyle also started the present working of Carn Brea Mines, and was the means of bringing West Basset, North Basset, and Great South Tolgus to a successful issue. Every success gained by such a veteran miner, and one who has persevered so determinedly through good and evil fortune, should be a matter of general congratulation. The Messrs. Thomas, of Threadneedle Street, well known for their connection with Devon Consols, have the good fortune to be large shareholders—having, for some years, been connected with Mr. Lyle in his mining enterprises in the neighbourhood of Redruth.

North Downs, as will be seen by our abstracts of accounts, has divided another 5*s*. per share, adding £162 to the reserve fund. Great hopes are now entertained that the rich course of ore driven over in the 50 east may

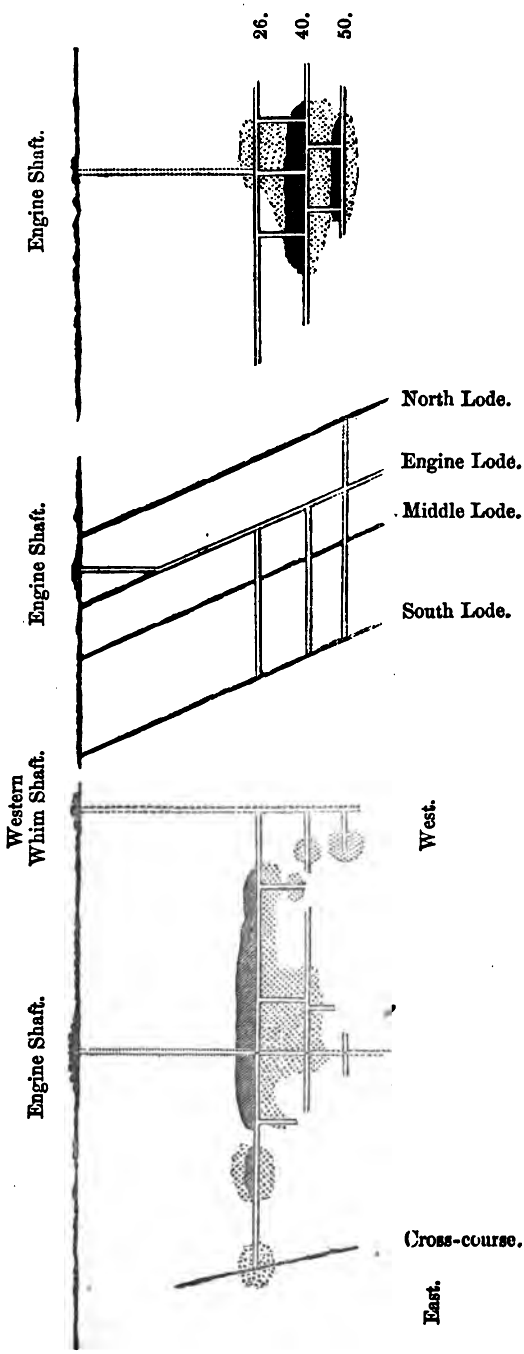
EAST CARN BREA MINE.

Scale 50 fathoms to an inch.

FIG. 3.
Longitudinal Section on South Lode.

FIG. 2.
Transverse Section.

FIG. 4.
Section on Middle Lode.



be soon intersected in the 60, that end having, during the recent driving, let down all the water from both the 50 ends. Of course this point is of immense importance.

Gwennap District.—The amalgamation of the United Mines and Wheal Clifford into one sett will, it is to be hoped, give such stability to the concern as to ensure its profitable working for many years. Among progressive things in this neighbourhood may be mentioned *Nanjiles*, *Wheal Moyle*, *Wheal Damsel* and *East Damsel*. The former mine is now in such hands that we may fairly expect to see it worked, at last, in a really vigorous manner. Wheal Moyle is turning out quite as successfully as could be expected for the time it has been at work, and its success is said to be likely to cause the reworking of Ting-Tang. Indeed this would probably have been already effected but for the dull state of trade and consequently of speculation. At the eastern part of Wheal Damsel, and at East Damsel, cross-cuts are now being driven to intersect the south lodes, which are drained to a considerable depth by the workings of their great neighbour, Clifford Amalgamated.

Wendron District.—This old tin district has been the scene of greater activity within the last year or so than it has ever been before. Numerous concerns have been put to work, but unfortunately many have proved unsuccessful, principally owing to being put into the hands of agents unaccustomed to the peculiarities of the district. The difference between management of this sort and really good local management is best shown in the case of *Basset and Grylls*, which hitherto has been a good mine spoiled by bad management; but which is now about to reward those who have had the courage to take to it after its great disaster. There are other concerns in the same neighbourhood, which, were they under the same or similar respectable management, might be expected to give equally good results.

The following is the last report on *Wendron Consols* of Captain John Taylor, by which it will be seen that that mine is progressing favourably in opening out its eastern ground called Bal Dees :—

The engine shaft men are driving west on engine lode at the 45-fathom level at £22 per fathom; lode 4 feet wide, worth £20 per fathom.

Bishop's shaft is being sunk below the 52-fathom level on engine lode by six men, at £35 per fathom; lode 3 feet wide, worth for length of the shaft (10 feet) £20 per fathom, and is likely to improve.

The 52 east of this shaft is driving by four men at £22 per fathom; lode 3 feet wide, worth £14 per fathom. The 52 west of same shaft is suspended for the present, while the men are engaged rising close behind the end for ventilation and to lay open the ground; lode in the rise 2 feet wide, worth £5 per fathom, and rising at £7.

The 42-fathom level is driving east of Bishop's shaft on engine lode by four men, at £13 per fathom; lode 2 feet wide, worth £14 per fathom.

The 32-fathom level is being driven east of Hurler's shaft on engine lode, at £14 per fathom; lode 2 feet wide, worth £10 per fathom. The tribute pitches in this part of the mine are improved.

Six men are driving the 80-fathom level west of Hill's shaft on Flander's lode, at £12. 10*s*. per fathom; lode 2 feet wide, worth £7. 10*s*. per fathom. The 40-fathom level is being driven west of same shaft on Flander's lode, at £10 per fathom; lode 3 feet wide, unproductive. Here our object is to get under the tin ground seen in the 20-fathom level, about 16 fathoms further west.

The 30-fathom level is being driven west on north lode by four men, at 12*s*. 6*d*. in 20*s*.

The 20-fathom level is being driven west on same lode by two men, at £2. 10*s*. per fathom, opening tribute ground.

Bal Dees diagonal shaft is being sunk below the 35-fathom level by six men, at £15. 10*s*. per fathom; lode 2 feet wide, worth £12 per fathom, and is improving.

Bal Dees perpendicular or new engine shaft is sunk 2 fathoms below the 35, and [illegible]t cut, bearers and cistern fixed, and we shall without delay begin to fix our

pitwork at that level. The new boiler is in its place, and the engineers are getting on as fast as possible in heaving in the engine, which we hope to get to work by the end of the year. When this is done, we shall be able to develope this part of the mine to a greater extent than we have hitherto been able to do; and, judging from the discoveries already made, we think this will soon be an important part."

New Tin-Smelting Company.—For many months past there has been considerable talk in West Cornwall—particularly at Redruth—about establishing a new tin-smelting company. The persons whose names were mentioned in the matter are of some influence in mining, and consequently would probably be able to procure a supply of tin under the present system —although some suggestions have also been made about again attempting to introduce a system of ticketing for tin ores. As most of our readers are aware, all the black tin raised in Cornwall—excepting two or three eastern mines—is now carried to some particular smelting-house, and there sold by private contract according to the "standards" of the day—the money value being calculated in the manner shown in page 25. The standard and allowances being the same all through the trade, there is no advantage (theoretically at least) in going to one house more than another; consequently, in choosing those to whom to sell their black tin, miners are influenced generally by collateral considerations. Hence, a new company without powerful mining influence would have no chance of getting any tin, for there is no open market into which they could go and outbid the present customary purchasers. The system of tin ticketings was tried some years ago, but failed.

Liskeard District.—Of this district, at present the most rising in Cornwall, we shall not say anything at present, as we purpose, in an early number, giving a detailed description of it.

WALES AND THE BORDERS.

Cardiganshire.—This district has been at once one of the most fortunate and one of the most unfortunate in the kingdom. Those mines which have had the good fortune to be under the management of Messrs. Taylors have had more than an average amount of success; while, strange to say, all started under other management have been complete failures—and these latter have not been few, or trifling in the money expended. Within the last twenty years scores of such concerns have been started, and immense sums of money lost, without one solitary success. This is too remarkable a result to be due to mere chance; and consequently our readers will not be surprised when we state that the contrast between Messrs. Taylors' success and the unvarying failure of others, is due to causes easily traceable and well understood by those acquainted with the history of mining in this district. It would be out of place to enter into these matters here; but we cannot refrain from suggesting to those who may be about speculating in Cardigan mines the advisability of making a few inquiries into the history of transactions in that district during the last fifteen or twenty years. That Cardiganshire is a great mining district is undoubted; but that from unhappy causes—and above all, from one unhappy cause—it has entailed a miserable amount of ruin on many unhappy speculators, is unfortunately still more clear.

Among those mines in this district which, from the respectability of their management, may be classed in the same category as Messrs. Taylors' mines, we may mention the concern now started as *Cardigan Consols*, of which Messrs. Phillips and Darlington are consulting engineers. With sufficient capital and proper management, these mines have every prospect of doing as well as the best in the district.

A step, which threatens to have a very serious effect on colliery property in the Flintshire and Denbighshire coal fields, has been recently taken by

the Mersey Dock and Harbour Board, who have imposed an additional tax of 3*d*. per ton on all coal shipped at Birkenhead, making, with the dock and town dues already levied, 6½*d*. per ton, or 5 per cent. on the value of the article as put on board ship, and nearly 10 per cent. on its value at the pit mouth. Birkenhead is the chief port for the shipment of the coal of North Wales; and as the article, though of inferior quality for domestic purposes, is well suited for exportation, a considerable trade has sprung up during the last dozen years. The Birkenhead docks were opened in 1846, and since that time the production of coal in North Wales has greatly augmented, a very large proportion of it finding its way to Birkenhead to be shipped there. From 1846 to 1857 the charges on coal exported, including use of rails, &c., was 2*d*. per ton; but when the Birkenhead docks came into the hands of the Mersey Board, the sum was raised to 3¼*d*. per ton, although no additional facilities were afforded for the extra dues levied: at present the facilities for shipment being far from being as extensive as they were before the opening of the Great Float. The former owners of the docks deemed 2*d*. per ton an adequate remuneration for the facilities afforded, and certainly no change has since been effected which would warrant the present owners in trebling the charge.

A memorial has been recently presented to the Board, by a number of gentlemen interested in the trade, and signed by the principal coal owners on the district, including the Brymbo and Broughton Companies, represented by Messrs. Darby; Messrs. Maurice and Low, of the Vron Colliery; the Bryn Mally and Westminster Brymbo Companies, and numerous others. The memorialists express their "surprise and regret" at the additional imposition, and compare it with the charges made at other ports:—At Garston, 2*d*. per ton; at Hartlepool, 1½*d*.; at Newcastle, ¾*d*.; at Cardiff, 2*d*.; at Swansea, 1½*d*.; and at Newport, 2*d*.; for which sums far greater and more extended accommodation is provided than at Birkenhead. They also append a list of articles, the dues on which vary from 1*d*. to 8*d*. per ton, but the value per ton of which greatly exceeds that of coal; and point out that if value is any criterion as to the extent of dues that ought to be levied, those on coal should be reduced instead of increased.

The following remarks of the "Colliery Guardian" on this extraordinary measure no doubt fairly represent the views of the colliery trade, not merely on this special case of exaction, but generally as to the arbitrary proceedings of railway boards and other bodies, in altering their rates to such an extent as to jeopardise large branches of industry.

"The motives which have actuated the Mersey Board in framing this scheme of extortion are altogether beyond ordinary comprehension. Before the Board was established, it was urged by many that, if the docks on both sides of the Mersey were placed under its jurisdiction, the trade of Birkenhead would be sacrificed to that of Liverpool whenever the two came into competition, and it may be insinuated that what is now really aimed at is the transference of the Birkenhead coal trade to the other side of the river. This supposition, however, is absurd, for in the first place the Mersey Dock and Harbour Board show no wish to encourage the Liverpool export coal trade, and in the next place, if the coal trade were driven altogether away from Birkenhead, very little more coal would be shipped from Liverpool, for neither the Wigan coal nor the St. Helen's coal could compete with that from North Wales in cheapness, and indeed in other points wherein it is peculiarly suitable for certain markets. Perhaps the Board aims merely at the increase of its revenues by thus roughly augmenting the charge on one of the principal articles of export. They are much more likely, however, to drive the trade somewhere else, or extinguish it altogether. The coal shipped at Birkenhead is not worth more than 5*s*. per ton at the pit's mouth, and on this price 6*d*. per ton is a very handsome profit; and, indeed we have a notion that the increased charge would itself absorb the profit in most cases. The price cannot be mate-

rially enhanced owing to the active strenuous competition at Newcastle and Cardiff, and thus, if the Board persist in its resolution to impose this additional charge, they will not only severely punish, and indeed grievously oppress the colliery owners who use the port of Birkenhead, but will completely stop the further development of the export coal trade there.

"On looking at the list of firms subjoined to the memorial, one cannot help feeling some astonishment that a body of gentlemen possessing a very large amount of capital invested in an important branch of industry, and employing a great number of workmen, should find their property placed at the mercy of an irresponsible board, who neither know nor care anything about their interests. A week or two ago we drew attention to a resolution of the London and North-Western Board, imposing an additional charge of 6d. per ton on all coal introduced by their line into the metropolis. A deputation of gentlemen waited upon the directors to prevail upon them, if possible, to rescind the resolution, but argument and remonstrance were ineffectual, and the increased charge is to be exacted. Surely these things, coming one after another, will awaken colliery owners throughout the country to a sense of the danger to which they are exposed from the arbitrary exactions of railway boards, and other bodies having control of the channels of traffic. A time will come when these impositions will be intolerable, and a remedy must be sought from the legislature by means of combined action. As respects the Birkenhead case, great credit is due to Mr. W. Laird for his energy and spirit in taking the matter up, and we trust that his efforts in abating the grievance will be decidedly successful."

Since the above was written, it has been decided at a meeting of the Mersey Dock Board—To fix a charge for the use of the coal tips at Birkenhead at 2*d*. per ton. The use of the low level to be free. A charge of one-halfpenny per ton to be made for weighing at either place.

South Wales Institute of Engineers.—The quarterly meeting of the members was held in the Assembly Room of the Castle Hotel, Merthyr Tydvil, on Thursday, the 12th Dec. The chair was occupied by the president for the year, Wm. Adams, Esq., of Ebbw Vale; and the vice-chair by W. S. Clarke, Esq., of Dowlais. There was a large attendance, including Thomas Evans, Esq., Government Inspector of Coal Mines for South Wales.

Owing to the inability of Mr. R. Schmidt to attend the meeting, the discussion on his paper upon "Professor Jenner's diagram for showing the motion of the slide valve," was postponed. It is likely to produce a considerable and animated discussion when taken into consideration, for it was intimated that another paper on the same subject, by Mr. W. C. Pearce, of Cyfartha, will be read at the next meeting. The Secretary then read a paper on "The Sanitary Condition of Mines," by Mr. Mark Fryar, of Glasgow. The writer expatiated upon the advantages of proper ventilation, considering the large number of men daily and nightly employed in the coal mines of Great Britain and Ireland. Everybody knew that the noxious gases were caused by the decomposition of the matter or stratifications which composed the coal, and these gases were emitted by the cutting. The paper then treated of the several means at present adopted for clearing off the noxious gases, and entered upon scientific data to prove what amount of pure air was necessary to dilute and render harmless the various noxious gases. Referring to the accidents caused by explosions, Mr. Fryar observed that, notwithstanding the loss of life by sea was large, it had been ascertained that the loss of life in mines was considerably greater. The sanitary condition of pits in the North of England was, generally speaking, much better than in Wales; and he hoped that colliery proprietors would adopt the means—scientific means—in their knowledge and power to ventilate the pits under their control. The paper was ordered to be printed in the Transactions of the Institute, and will be discussed at the next meeting, and a vote of thanks was awarded to Mr. Fryar. Mr.

A. Murray's paper upon the "Pembrokeshire Coal Fields" was not received in time, and its reading was therefore postponed until the next quarterly meeting. Papers were then read by Mr. G. Ashcroft, on "A Plan to improve Canal Locks, and to render canal carriage less costly," and by Mr. T. D. Steel, on "Giffard's Injector." The papers were not discussed, being ordered to stand over until the next meeting, to allow of their publication in the Transactions.

Rating of Collieries and Mines.—The following communication on this subject appears in the *Mining Journal*, and communications to a similar effect have appeared in the *Colliery Guardian*:—Complaints are continually being made of the manner in which collieries are assessed for poor and highway rates. From the information collected by Mr. Kendall, when he had his bill for taxing metallic mines before the House of Commons, the opinion seems universal that improvements in the law of rating both collieries and metallic mines are absolutely called for. Whether the impartial discussion of the subject will result in the taxation of all mines, or in their exemption, it is almost impossible to predict, but the opinion is certainly in favour of the former course—the taxation being upon an equitable and easily-understood principle. From the remarks of the various authorities who have handled the subject, it seems that the greater proportion consider that, if all mines were rated upon half of the amount paid over to the lessor or lord, no one would object, and there would be general satisfaction.

It is rumoured that, in the ensuing session, the subject of the rating of mines will be revived in all its force, and, if Mr. Kendall and his supporters include both coal and metallic mines under one Act, the point may be readily settled, and lasting benefit will be conferred upon all. The sole basis for the rate should be the royalty paid by the person working the mine or colliery, and the onus of proving that the tax is leved on too high an amount should be thrown upon the party by whom the tax is to be paid.

MIDLAND COUNTIES.

South Staffordshire.—The *Mining Journal* correspondent reports:—The preliminary meeting of the Ironmasters' Association was held at Dudley this afternoon. It excited comparatively little interest, as no change in prices was expected. Trade is very quiet, but a reduction in the price of finished iron below £7 for bars, the present price, would not readily be submitted to; and the political aspect, in respect to peace or war with America, is so uncertain that a change would not be thought of under present circumstances, even if existing rates offered more margin for reduction. The sale of pig-iron for the next quarter has not commenced, and sellers' prices remain at £3. 7*s*. 6*d*. to £3. 5*s*. for very best makes of hot-blast native pigs, £3. 2*s*. 6*d*. to £3 for a good quality of all mine pigs, declining to as low as £2. 5*s*. for very inferior flue cinder pigs. Hematites are offered at £3. 5*s*., and although £3. 9*s*. is talked of, the Barrow Company, whose quality is unexceptionable and unquestioned, are open to sell at the former rates. North Staffordshire makers are asking more money, and £2. 15*s*. to £2. 17*s*. 6*d*. is quoted for best makes.

Referring to the present entire absence of trade, the *Colliery Guardian* correspondent remarks:—It is true, that in some cases orders might have been booked if makers would accept rates utterly profitless, if not such as would have entailed a direct loss. Offers of such rates have been unblushingly made by persons who have thought that makers at this juncture would be prepared to accept almost any prices, but the issue has proved that this is not the case. Makers cannot now afford to send out iron that costs them more than they receive. Business must now be done in South Staffordshire on legitimate terms, and although low rates are being accepted by some makers, yet they are rates at which a profit can be made. The

absence of orders is due not so much to the period of the year as to the continued uncertainty respecting the political relations between this country and America at the beginning of next year. On that account, the preliminary meeting which was held on Thursday at Dudley was a very dull affair. The Christmas holidays prevented many from attending, and others were kept away by the knowledge that there was no business to be done.

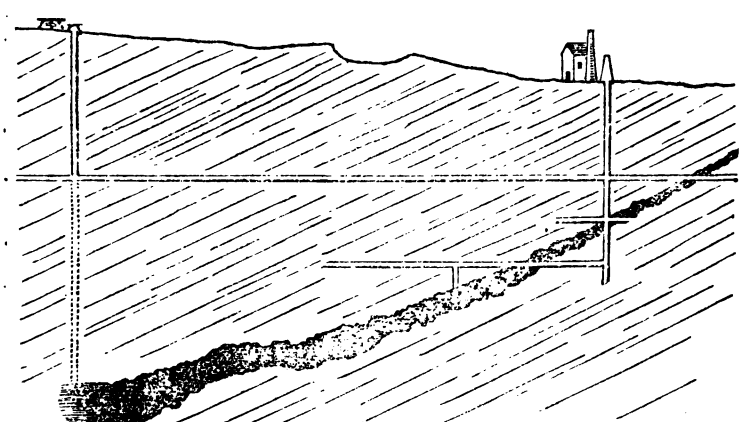
NORTH STAFFORDSHIRE.—This mining district, which is reported to have been first brought into notice by Prince Rupert, and which has long been known for the exceptional productiveness of a single mine, has within recent years been comparatively neglected, and indeed has never been tried but to a very limited extent—the explorations not extending more than 8 miles from north to south, by 4 miles from east to west.

The only mine at present of much note in the district—the Dale Mine—is in the northern part of the district, in the township of Warslow, in the parish of Alstonefield. It is bounded on the south by the once celebrated Ecton Mine, the property of the Duke of Devonshire, which in former workings yielded immense treasures of copper and lead to the Cavendish family. What these amounted to is not exactly known; but they are reputed to have reached two millions and a half. This estimate may be exaggerated; but it cannot be excessively so, for an examination of the enormous excavations shews that the returns must have been very unusual for the quantity of ground opened. The principal vein was of that character which in this district is called a "Pipe Vein,"—which seems to be formed by the concentration of a great number of cross veins in a certain run of ground:—the union of these veins forming a pipe or shoot of ore generally of great richness and value, and extending regularly to considerable depths, but having only a very limited length.

One of these "Pipe Veins"—very similar to the great Ecton Pipe—is now being worked in the Dale Mine, and its form is shown in the accompanying section of that mine given in Figure 5. The strata in which

FIG. 5.

Scale 50 fathoms to 1 inch.



it occurs is the carboniferous limestone,—the mineral character of the measures being an alternation of limestone and shale—the latter, however, frequently thinning out, or at least altering in mineral character, in depth. The beds are highly contorted, their convolutions somewhat resembling

the letter S. When the strata have this form they are locally termed saddles—"Huckle Saddles," and "Trough Saddles;" the former term being applied to the convex measures, and the latter to the concave measures. Great practical importance is attached to the relation between the veins and these two distinct forms of saddles—for in connection with them the largest deposits of ore are usually met with. The pipe vein now working in the Dale Mine is in "Saddle Ground;" and as far as yet traced it increases in size and value (as indicated in the section) as the works extend downward. Even at the present depth its full value is not known, as its whole extent is not included in the workings; but that part excavated is worth about £200 per fathom. It will be seen from the accompanying section that the present workings on this pipe are being prosecuted at an enormous disadvantage, in being pursued by workings extended from the present engine shaft, which is far behind that part of the pipe now wrought. These workings are in fact under where the new engine shaft is now being sunk, as shown by the dotted line. If this shaft were now down the ore could undoubtedly be taken away at a very fine profit; but the present difficulties, and consequent expenses, are so great that all the returns are absorbed in cost. The difficulties of drawing the stuff—of pumping the water—and of even ventilating the workings—will be readily appreciated by every one acquainted with mining, by a glance at the section; the drawing taking place through half dozen inclined winzes by hand-tackle. Nothing but a bunch of ore of extraordinary richness could pay for taking away under such enormous disadvantages; indeed, it is a matter of regret to see ore taken away at all under such circumstances, and it is only to be justified by that proverbial necessity which knows no law. Beyond this necessity, a collateral advantage may also be gained by pursuing the present course of workings on the pipe vein, if, as it is hoped, they should result in draining the water from the new shaft. This would be an immense advantage, for it would enable that important work, upon which so much depends, to be sunk not only with greater dispatch but without the expense of separate pit work.

When the shaft is communicated to the pipe vein the Dale Mine will assume a very different position, for the ore will then be in a position to be taken away at a reasonable cost, and in a fair, miner-like manner. We may state that before reaching this pipe vein, this shaft is expected to intersect another productive vein. That the present working position of this mine is not all that could be wished is evident from what we have said; but no blame, in this respect, is to be attached to the present management, for Captain Niness has left nothing undone that could be done since the management has been under his control. It certainly is unfortunate to find a mine with one of the richest courses of lead ore in the United Kingdom in such a working position as to be unable to return it to any profit. Difficulties of this kind, however, are not so very uncommon in limestone districts, where the shoots of ore—often very rich in themselves and of great regularity—dip at a moderate angle from the horizon, and having no great horizontal length, present very peculiar difficulties in working—difficulties which can hardly be appreciated by those accustomed to the metalliferous formations of killas or granite districts.

DERBYSHIRE.—The following extraordinary production of coal at the Seymour Pit, at the Staveley Collieries, is worthy of notice:—This colliery was named by Richard Barrow, Esq., the proprietor, after the name of the present resident underviewer, Martyn Seymour, Esq., who stated, at the time the colliery was being laid down, that he would not rest satisfied until the Seymour Pit produced 1,000 tons of coal per day. On Friday last, the extraordinary quantity of 1,147 tons 17 cwt. was raised without the use of more than ordinary efforts. Out of this immense quantity there ·re only 25 tons and 9 cwt. of slack. The pit is so laid out that the

work is performed without the slightest confusion, the men being kept well under control by the overmen, Richard Hepplethwaite and Thomas Young. It must be a source of great gratification to Mr. Barrow that Mr. Seymour has so handsomely redeemed his promise.

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—The *Colliery Guardian* correspondent reports the position of this district during the latter half of the month as follows:—Matters appear to be going on pretty much as usual, and no material alteration for either better or worse is expected for some little time to come. There is an active demand for household and gas coal, but collieries that yield other varieties characteristic of the district are doing very badly. With respect to mining operations in the great northern coal-field generally:—Hartley Pit has been flooded with water lately, but has been again re-opened. The sinking at the Bedlington new pit progresses very slowly, owing to the quantity of water met with; this is issuing from a kind of quicksand. At the Newsham new pit a few coals are drawn daily, and it is expected to be ready for active operations early in the spring. The Bebside Colliery is one of the most extensive in the district, and 30 keels of screened coals are sent away daily, no less than 550 coal hewers being employed. Some new "winnings" are projected in this district. When the trade again revives, some movement will, no doubt, be made about them during the ensuing year. The collieries on the Wear are doing better than those in Northumberland, the gas and house coal collieries being pretty well employed. The operations underneath Lambton Castle are still in progress, for the purpose of securing the foundation of the structure, and in the course of them some curious phenomena have taken place. A bore-hole was put down from the Maudlin seam to the Hutton seam; when it holed a great quantity of gas came off, the men had to leave the rods in the hole, and the gas soon filled the lamps at the surface. After standing three weeks, the men went down to get the rods out of the hole. After they got them out the gas came away again, and men are now watching to prevent any one going to or near the pit's mouth with a light, as the gas would ignite at once near the surface. On Saturday last very large fleets of laden colliers, which had been detained by adverse winds, put to sea, no fewer than 250 having left Sunderland alone. The exports from the Tyne during the week ending December 14, include 20,188 tons of coal, 2,481 tons of coke, 3,897 cwt. of iron, and 3,506 cwt. of alkali, showing an increase in the shipments of alkali of 2,646 cwt., and a decrease in the shipments of coal of 3,974 tons, coke 797 tons, and iron 623 cwt. Among the imports during the same period were a cargo of iron pyrites from Antwerp.

During the last week the coal trade remains dull, but the increased activity in our iron manufacturing establishments to which we alluded a week or two ago, is maintained. The chemical market, too, is a trifle better, a considerable demand having arisen for exports to France. The freight market is in a state of suspense, few shipowners appearing inclined to speculate until it is known with certainty whether we are likely to go to war with America. What with depression in trade, the open and unhealthy weather, the uncertainty of the American affair, and the melancholy death of the Prince Consort, this is the dullest Christmas we have experienced for many years. The exports from the Tyne during the week ending Saturday, the 21st December, were 27,289 tons of coals; 3,297 tons of coke; 3,325 cwts. of iron; and 2,644 cwts. of alkali; being an increase in the shipments of coal amounting to 7,051 tons, and coke to 816 tons, and a decrease in the shipments of iron of 572 cwt., and of alkali 862 cwt.

COLONIAL AND FOREIGN.

New South Wales.—The great strike among the colliers of the Newcastle coal-field, New South Wales, threatens to be attended with the most extraordinary results. The extent of this coal-field is as yet but imperfectly known. The area, however, is very large—not less, certainly, than 60,000 or 70,000 acres, and probably much more. The qualities of the coals of the different mines vary considerably, but they have all steadily risen in commercial estimation as they have become better known; and being now sent to market in a more carefully prepared state than formerly, they are fast finding their way into the Eastern, as well as Colonial ports, for steam purposes. The rate of production previous to the strike was estimated at over 300,000 tons per annum. The total number of miners employed in the district was about 900; of these about 700 have joined the present strike, of whom one-fourth have probably left the district or taken to other pursuits. The question first arose at the Minmi colliery, the property of Messrs. Brown. There had been a fall in the price of coals both at Sydney and Melbourne some time in October last, and the Messrs. Brown gave notice of a reduction of 6*d.* per ton, which at once set the men up in arms. There had been several increases of price during the twelve months preceding, inasmuch as the getting price had risen from 3*s.* 6*d.* to 4*s.* 3*d.* per ton, but the men would listen to no reason why any reduction should be made. Once a price was given, no matter from what emergency it was granted, they would not allow of its being reduced again. So they struck work, and held out for ten weeks, the society at Newcastle paying each collier one pound per week, to the number of 110 men. As the other collieries continued working, Messrs. Brown after a time had to give way. The men, elated by their success, became dictatorial, and interfered with the employment of new hands. No collier was allowed to work at any of the mines without being a member of the Union; and on any difference between employers and workmen, the latter decided the question with the ultimation "Give in or we strike." The men earned on an average from £2. 12*s.* to £2. 18*s.* per week, and might have earned from £3. 5*s.* to £3. 10*s.* This dictation went off step by step until at the present time all the large collieries in the district are stopped, including those of the Australian Agricultural Company, the Wallsend Company, the Coal and Copper Company, Tomago (Captain Williamson's) and Minmi before mentioned.

The Workmen's Union, called the "Miners' Association," has now determined upon establishing a co-operative colliery of their own. For this purpose they have taken a block of land at a royalty of 6*d.* per ton, paying £100 deposit; and they are said to have received offers of assistance from capitalists to the extent of £20,000 if required, but are determined to limit their operations to their own resources. The manager and committee will be elected by the votes of all the miners.

The capital represented by the collieries stopped by the disastrous strike amounts to some hundreds of thousands of pounds.

Since the above was written, intelligence has been received of the termination of the strike. Having lasted exactly eight weeks, it came to an end in the early part of October. With respect to the result of the contest, it appears that the wages remain very nearly the same as before the strike. A concession of 3*d.* a ton has been made by the miners, but then the employers undertake the wheeling of the coal; so that there is a compensation. The masters have failed in enforcing the reduction of 20 per cent.; and have failed also in their attempt to break up the dominating control of the union. The victory, therefore, rests with the men, and this may compensate them for the loss of two months' wages. The masters have gained nothing to compensate them for the loss of two months' profits. The only result which may be said to be adverse to the men and favourable to

the employers is one that will operate indirectly. The effect of the discussion that has taken place has been to show that the Newcastle coal-miners earn far more than the average wages of the labouring class. It has been published far and wide that in a short day's work a coal-miner can earn 11*s*. 4*d*. with ease. This is considerably above the average net earnings of gold-diggers, and is above the pay of artisans in the city. The last account of the co-operative movement states that owing to the quantity of water in the Cowper Pit, and the miners not being possessed of proper boring tools, the further sinking has been stopped for the present. Operations at the other pit were also stopped by the miners returning to their own collieries.

LABUAN COAL MINES.—From Singapore favourable accounts have been received of the prospects of the Labuan coal mines. The preparatory works have been prosecuted with energy, and the health of the island has improved. No difficulty seems to be anticipated in procuring Chinese and Malay labour, and it is probable that the coal will be raised by contract. Although the clearing out of the mine and the repairs of the old plant required to be completed, a small quantity of coal was already being regularly brought out. A new pit is to be sunk, but this will not be done until coal to some extent has been raised from the present workings. The mail of next month will bring a full report.

Mining, Quarrying, and Smelting Accounts and Meetings.

CORNWALL AND DEVON.

AT the PROVIDENCE MINES (November 27) the accounts for the three months ending October showed—Balance last audit, £235. 8*s*. 4*d*.; tin sold, £5,450. 4*s*. 10*d*.; sundries, £7. 17*s*. 6*d*.=£5,693. 10*s*. 8*d*.—Mine cost, merchants' bills, income tax and sundries, £4,105. 5*s*. 7*d*.: leaving credit balance, £1,588. 5*s*. 1*d*. A dividend of £1,120 (£1 per share) was declared, and £468. 5*s*. 1*d*. carried to credit of next account.

At the WEST CARADON MINE (November 29th) a statement of accounts for July and August showed—copper ore sold, £4,393. 5*s*. 10*d*.; carriage, £109. 9*s*. 1*d*.; materials sold, £34. 14*s*. 1*d*.; interest, £5. 10*s*. 3*d*.; income tax deducted from dues, £41. 7*s*. 11*d*.=£4,584. 7*s*. 2*d*.—Mine cost, July and August, £2,671. 19*s*. 11*d*.; merchants' bills, £712. 14*s*. 1*d*.; dues, £282. 7*s*. 2*d*.; incidental expenses, £1. 5*s*. =£3,668. 6*s*. 2*d*.: leaving balance profit, £916. 1*s*. The profit and loss account showed a balance of assets over liabilities of £5,519. 1*s*. 7*d*. The total assets, including reserve fund, and Caradon and Looe Railway stock, to be presented at the next meeting, amounted to £7,263. 14*s*. 11*d*. The profit upon the September and October workings was £957. 12*s*. A dividend of £1,024 (£1 per share) was declared, and a balance of £4,495. 1*s*. 7*d*. carried to the credit of the next account.

At WHEAL MARGARET (November 27) the accounts for the three months ending September showed—Balance last audit, £305. 15*s*. 11*d*.; tin sold, £3,558. 7*s*. 4*d*. =£3,864. 3*s*. 3*d*.—Mine cost, merchants' bills and sundries, £2,697. 10*s*. 6*d*.: leaving credit balance, £1,166. 12*s*. 9*d*. A dividend of £896 (£1 per share) was declared, and £270. 12*s*. 9*d*. carried to credit of next account.

At WHEAL HENRY meeting (December 2) the accounts showed a debit balance of £206. A call of 4*s*. per share was made.

At the BOSCEAN MINE (December 3) the accounts for the quarter ending September showed—Balance last audit, £1,085. 14*s*. 3*d*.; tin sales (less dues), £3,010. 11*s*. 3*d*.=£4,096. 5*s*. 6*d*.—Mine cost, &c., £2,741. 12*s*. 3*d*.: leaving credit balance, £1,354. 13*s*. 3*d*. A dividend of £300 (£1. 5*s*. per share) was declared, leaving £1,054. 13*s*. 3*d*. to credit of next account. Captains R. Berryman, J. Trezise and J. Rowe, reported that—"during the past quarter we have effected a considerable alteration in one of our water-stamps situated on the mine

by the erection of a new wheel, to which we have attached sixteen heads, and purpose adding immediately eight more; this will give us through a great portion of the year excellent stamping-power by means of water, and thus greatly lessen the consumption of coals at our steam-stamps."

At Wheal Basset (December 3) the accounts for September and October showed—Balance last audit, £934. 18*s.* 3*d.*; ore sold (deducting £287. 4*s.* 1*d.* dues, at 1-15th), £4,020. 17*s.* 4*d.*; sundries, £3. 2*s.* 1*d.*=£4,958. 17*s.* 8*d.*—Mine cost, merchants' bills, and sundries, £2,385. 15*s.*: leaving credit balance, £2,573. 2*s.* 8*d.* The profit on the two months' working was £1,638. 4*s.* 5*d.* A dividend of £1,024 (£2 per share) was declared, and £1,549. 2*s.* 8*d.* carried to credit of next account.

At South Crofty Mine (December 3) a call of 10*s.* per share was made.

At the Great North Downs Mine (December 4) the accounts showed—Balance last audit, £4,166. 13*s.* 10*d.*; May mine cost, merchants' bills, &c., £522. 6*s.* 5*d.*; June ditto, £400. 13*s.* 10*d.*; July ditto, £433. 14*s.* 2*d.*; August ditto, £334. 17*s.* 11*d.*; September ditto, £301. 13*s.* 11*d.*; October ditto, £299; dues, £31. 3*s.* 2*d.*= £6,490. 3*s.* 3*d.*: call, £4,250.; copper ore sold, £812. 15*s.* 9*d.*=£5,062. 15*s.* 9*d.*: leaving debit balance, £1,427. 7*s.* 6*d.* A call of £1 per share was made, 10*s.* to be paid down and 10*s.* on April 1.

At the Great Brigan Mine (December 5) the accounts showed a debit balance of £1,427. 7*s.* 6*d.* A division of the back costs was made, which amounted to a call of 5*s.* per share. The appointment of Mr. E. King as secretary was confirmed, and a committee of management appointed.

The Tincroft Mining Company declared a dividend of 5*s.* per share on December 5. This is the thirtieth dividend already paid, amounting to £10. 18*s.* 6*d.* on each £9 share.

At the South Wheal Seton (December 5) the accounts for the four months ending October showed—Balance last audit, £66. 9*s.* 11*d.*; mine cost, merchants' bills, and sundries, £803. 6*s.* 7*d.*=£869. 16*s.* 6*d.*—Calls received, £600: leaving debit balance, £269. 16*s.* 6*d.* A call of £2 per share was made. Captains Bath and Higgins reported upon the various points of operation.

At the Dolcoath Mine (December 9) the accounts for September and October showed—Balance last audit, £435. 7*s.* 9*d.*; sales of tin ore, £11,511. 19*s.*; copper, £418. 13*s.* 2*d.*; sundries, £397. 19*s.* 4*d.*; less dues and rates, £597. 2*s.* 2*d.*= £12,166. 17*s.* 1*d.* Mine cost, £5,533. 13*s.* 7*d.*; merchants' bills, £2,037. 10*s.* 11*d.*; water and other rents, £152. 0*s.* 11*d.*; balance of new engine and pitwork, £950. 19*s.*; showing a profit on the two months' working of £3,057. 4*s.* 11*d.*—By dividend of £2,864 (£8 per share), and payment of income tax on profit (£100. 8*s.* 8*d.*), leave to credit of next account £528. 4*s.*

At Wheal Seton (December 9) the accounts for September and October showed —Balance last audit, £941. 10*s.* 8*d.*; copper and tin ore sold (less dues,) £2,461. 14*s.* 4*d.*=£3,403. 5*s.*—Mine costs, including merchants' bills, £2,000. 17*s.* 5*d.*: leaving credit balance, £1,402. 7*s.* 7*d.*—By dividend, £594 (£1. 10*s.* per share), leaves to credit of next account, £808. 7*s.* 7*d.*

At Wheal Mary Ann (December 10) the accounts for the three months ending September showed—Balance last audit, £1,508. 11*s.* 2*d.*; ore sold, £5,178 10*s.* 11*d.*= £6,687. 2*s.* 1*d.*—Mine cost, merchants' bills, and sundries, £4,601. 8*s.* 9*d.*: leaving credit balance, £2,085. 13*s.* 4*d.* The profit on the three months' working was £577. 2*s.* 2*d.* A dividend of £512 (£1 per share) was declared. and £1,573. 13*s.* 4*d.* carried to credit of next account. Captains Clymo, Hodge, Harris, and Stevens reported upon the various points of operation. The stopes and pitches are producing much the same as they have for some time past.

At the Nangiles Mine (December 10) the accounts showed—Mine cost, merchants' bills, and sundries, £2,315. 13*s.* 7*d.*—Balance last audit, £117. 0*s.* 10*d.*; calls received, £1,024; ore sold, £124. 7*s.* 4*d.*: leaving debit balance, £1,050. 5*s.* 5*d.* A call of £1 per share was made. The Dublin office of reference is to be dispensed with at the end of the present month.

At Cargoll Mine (December 9) the accounts for the three months ending September showed—Balance last audit, £609. 13*s.* 6*d.*; lead ore sold, £3,189. 14*s.* 2*d.*= £3,799. 7*s.* 8*d.*—Mine cost, merchants' bills, and sundries, £3,297. 3*s.* 10*d.*: leaving credit balance, £502. 3*s.* 10*d.* The amount received for lead ore sold during the quarter has exceeded the expenditure for labour and materials, exclusive of machinery, by £424. 13*s.* 11*d.* Captains Grose and Tyzzer reported upon the various points of operations. There are 93 tons of ore sampled and ready for sale.

They have at present employed on the mine 61 men and 4 boys on tribute; 52 men and 6 boys on tutwork; 1 pitman, 7 tillers and landers, 7 enginemen, 1 carpenter, 2 smiths, 2 sawyers and a boy, 5 owners' account men, and 1 dryman; and in dressing ore 8 men, 33 boys and 15 girls; and 15 persons dressing halvans. They are progressing favourably with the erection of the engine house, on which there are 10 masons and tenders employed.

At Durlo Mine (December 10) the accounts for the quarter ending October showed—Balance last audit, £285. 5*s*. 11*d*.; sale of tin, £1,679. 2*s*. 10*d*.; sundries, £4. 8*s*. 8*d*.=£1,968. 17*s*. 5*d*.—Mine cost, £1,483. 13*s*. 3*d*.; merchants, £391. 13*s*. 1*d*.; dues and interest, £81. 16*s*. 3*d*.: leaving to credit, £11. 14*s*. 10*d*. The loss on the quarter's working was £273. 11*s*. 1*d*. Captain R. Blight was appointed a day and night agent at £7. 7*s*. per month. Captains R. James and B. Martin thus conclude their report—"This is the extent of our tutwork operations, employing 49 men; we have 20 pitches, employing 46 men: total, 95 men, at an average of 10*s*. in £1, at the present price for tin."

At the Spearn Moor Mine (December 13) the accounts for July, August and September showed – Balance last audit, £47. 12*s*. 7*d*.; labour cost, £981. 18*s*. 4*d*.; materials, coals, &c., £298. 17*s*. 6*d*.=£1,328. 8*s*. 5*d*.—By tin sold, at an average price of £68. 6*s*. 7*d*. per ton (less dues and income tax), £985. 6*s*. 7*d*.: leaving debit balance, £343. 1*s*. 10*d*. Captains J. Bennetts and C. Ellis reported on the mine: they have 65 men and 7 boys employed in the mine on tutwork and tribute; the tribute average is 12*s*. in £1.

At East Carn Brea Mine (December 17) the accounts for September and October showed—Balance last audit, £1,929. 3*s*. 10*d*.; mine cost, merchants' bills, and sundries, £1,547. 16*s*. 3*d*.=£3,477. 0*s*. 1*d*.—Calls received, £1,477. 15*s*.; copper ore sold, £1,710. 4*s*. 8*d*.: stores sold, 10*s*. 3*d*.; advance on tribute, £80: leaving debit balance, £208. 10*s*. 2*d*. Captain T. Glanville reported that their next sampling, on December 26, would be about 300 tons of copper ore; and the cost for the next two months will be about £800 per month. It was resolved that all reports forwarded to the office from the mine be in future signed by all the underground agents.

At the North Wheal Basset (December 18) the accounts for September and October showed—Balance last audit, £387. 7*s*.; mine cost, merchants' bills, and sundries, £1,490. 0*s*. 6*d*.=£1,877. 7*s*. 6*d*.—Tin and copper ores sold and sundries, £698. 9*s*. 9*d*.; calls received, £757. 13*s*.: leaving debit balance, £421. 4*s*. 9*d*. A call of 3*s*. per share was made. Captains Glanville and Davey reported that they would sell on December 17 about £170 worth of tin ore, and on the 26th would sample about 100 tons of copper ore. Their cost for the next two months will be about the same as last—£700 per month.

At the Great Wheal Vor United Mines (December 18) the accounts made up to the present date showed—Audited cash account to October 31, 1861, £2,470. 4*s*.; tin sale, November 13, £1,512. 13*s*. 8*d*.; ditto, December 14, £1,612. 5*s*.; sale of plant, £115. 6*s*. 7*d*.; sundries from the mines, £15. 18*s*. 6*d*.; total, £5,726. 7*s*. 9*d*. And paid: October cost, £1,155. 5*s*. 11*d*.; sundries, £3. 17*s*. 2*d*.=£1,159. 3*s*. 1*d*.—Balance (cash and bills), £4,567. 4*s*. 8*d*. The actual account as it stands this day is as follows:—Assets; Balance as above, £4,567. 4*s*. 8*d*.; arrears of call, £12. 0*s*. 8*d*.; materials sold, £264. 4*s*. 3*d*.= £4,843. 9*s*. 7*d*. Liabilities: November cost, £1,243. 13*s*. 7*d*.; sundries (say), £200=£1,443. 13*s*. 7*d*.—Balance in favour of mines, £3,399. 16*s*. The committee add that, under the circumstances of so large an amount of work done, and that a distribution of 12*s*. 6*d*. per share has been divided amongst the shareholders, the present financial position may be considered highly satisfactory, and they venture to hope, from the present favourable prospects of the mine, to be able to recommend a dividend to the shareholders at the next meeting.

At Bedford United Mines (December 19) the accounts for the three months ending October showed—Balance last audit, £1,105. 14*s*. 1*d*.; ore sold and sundries, £3,531. 11*s*. 5*d*.—£4,637. 5*s*. 6*d*.—Mine cost, merchants' bills, and sundries, £3,168. 5*s*. 6*d*.: leaving credit balance, £1.469. A dividend of £600 (3*s*. per share) was declared, and £896 carried to credit of next account. Mr. Wolferstan and Captain Phillips reported that, according to their present prospects and the value of the load in the western part of the mine, the usual returns can be made without diminishing the reserves.

At Great South Tolgus Mine (December 19) a dividend of 5*s*. per share was declared, after payment of which there remains a balance of £1,813. 9*s*. 7*d*.

in cash, and £1,903. 2*s*. 10*d*. ore bills not at maturity, applicable to the general purposes of the mine.

At the TREVENEN AND TREMENHEERE MINE (December 19) the accounts showed—Balance last audit, £1,306. 15*s*.; May mine cost, £555. 11*s*. 6*d*.; June, £559. 0*s*. 11*d*.; July, £605. 4*s*. 11*d*.; August, £558. 6*s*. 7*d*.; September, £574. 6*s*. 6*d*.; October, £578. 7*s*. 6*d*.; London agency (six months), £18. 18*s*.; expenses of general meeting held at Helston, bankers' charges for interest and commission, £81. 3*s*. 10*d*.; dues, £103. 5*s*. 5*d*.=£4,941. 0*s*. 2*d*.; calls received, £1,170. 10*s*. 6*d*.; tin sold, £1,858. 17*s*. 11*d*.=£3,029. 8*s*. 5*d*.: leaving debit balance, £1,911. 11*s*. 9*d*. A call of 7*s*. per share was made payable in two instalments.

At the NORTH DOWNS MINE (December 20) the accounts showed—Balance last audit, £1,294. 1*s*. 7*d*.; materials sold, £12. 16*s*. 5*d*.; copper ore sold, £4,986. 12*s*. 8*d*.; club account, £2. 16*s*.; income tax, £11. 0*s*. 8*d*.=£6,307. 7*s*. 4*d*. Dividend last meeting, £750; mine cost, July to October, £2,116. 17*s*. 7*d*.; merchants' bills, £956; dues, £249. 6*s*. 7*d*.; interest account, £10. 17*s*. 11*d*.; incidental expenses, £1. 5*s*.; law charges, £16. 1*s*. 8*d*.=£4,100. 8*s*. 9*d*.: leaving credit balance, £2,206. 8*s*. 7*d*. A dividend of £1,500 (5*s*. per share) was declared, leaving a balance of £706 to be carried forward to the credit of the next account.

At CARNYORTH MINE (Dec. 16) the accounts for July, Aug., and Sept. showed—Mine cost, £1,424. 15*s*. 9*d*.; merchants' bills, £232. 1*s*. 5*d*.; coal, £126. 11*s*. 9*d*.; lords' dues, £64. 0*s*. 5*d*.=£1,847. 9*s*. 4*d*.—Received for tin, £1,536. 11*s*. 7*d*.; sundries, £7. 10*s*.—making loss on the quarter's working, £303, 7*s*. 9*d*., which added to debit at last audit, leaves £1,271. 8*s*. 2*d*. now against adventurers. A call of 5*s*. per share was made. Capts. J. Carthew, W. Trembath, and J. Wallis reported on the mine.

At the GREAT WHEAL BUSY UNITED meeting (Dec. 23) the statement of accounts for the three months ending Oct. showed:—

Aug. mine cost, merchants' bills, &c., £3,420. 15*s*. 8*d*.; Sept. ditto, £2,916. 9*s*. 4*d*.; Oct. ditto, £3,032 10*s*. 4*d*.=£9,369. 15*s*. 4*d*. Balance last audit, £284. 13*s*. 7*d*.; Copper ore sold, £6,297. 13*s*. 4*d*.; Tin sold, £2,520. 15*s*. 5*d*.=£9,103. 2*s*. 4*d*. Balance (debit), £266. 13*s*.

A very satisfactory report was received from the manager. An analysis of the accounts showed a profit on Wheal Busy alone of £1,600 for the quarter.

At HINGSTON DOWN CONSOLS (Dec. 24) the accounts for the two months ending October showed—Balance last audit, £76. 19*s*. 1*d*.; ores sold, £1,158. 17*s*. 7*d*.; calls received, £260. 1*s*. 6*d*.; carriage, £128. 9*s*. 11*d*.=£1,624. 8*s*. 1*d*.—Mine cost, merchants' bills, and sundries, £1,526. 19*s*. 7*d*.: leaving credit balance, £97. 8*s*. 6*d*. Captain T. Richards reported that the sampling on December 31 will be about 360 tons of fair quality ore, and, on the whole, he considers their present prospect very encouraging. The cost for the ensuing two months, including the new and Bailey's engine-shafts, will be about £1,600.

WALES.

At MOUNT PLEASANT Lead Mine meeting (Dec. 6) the accounts for the five months ending November showed—Balance last audit, £313. 9*s*. 6*d*.; lead ore sold, £3,622. 10*s*.=£3,935. 19*s*. 6*d*.—Mine cost, merchants' bills, royalty, and sundries, £1,516. 0*s*. 7*d*.: leaving credit balance, £2,419. 18*s*. 11*d*. The profit on the five months' working was £2,106. 9*s*. 5*d*. A dividend of £800 (£1. 5*s*. per share) was declared, and since the last meeting four monthly dividends, amounting to £1,600 (£2. 10*s*. per share) have also been declared, leaving now £19. 18*s*. 11*d*. to the credit of next account. Captain Robert Williams reported upon the various points of operation. He considers that the mine has never been so rich during his agency as it is at present.

IRELAND.

At the GENERAL MINING COMPANY for Ireland (Dec. 2) the accounts for the half-year ending Oct. 2 showed—Balance last audit, £4,252. 1*s*. 2*d*.; ore sold, £725. 11*s*. 3*d*.; transfer fees and sundries, £31 10*s*. 5*d*.=£5,009. 2*s*. 10*d*.—Mine cost, merchants' bills and sundries, £3,405. 13*s*. 5*d*.: leaving credit balance £1,603. 9*s*. 5*d*. Captain W. G. Roberts reported upon the operations at the mines. The dressing of the calamine is going on well, and arrangements have been made for saving the chrc, a ready sale for which it is expected will be found.

At the CROOKHAVEN MINE annual meeting (Dec. 23) the accounts made up to November showed a balance in favour of assets of £942. The uncalled capital amounted to £9,831.

COLONIAL AND FOREIGN.

At the half-yearly meeting of the ST. JOHN DEL REY MINING COMPANY, (December 13), Mr. John Hoskin (managing director) submitted the report of the directors. The season had, on the whole, been favourable, and an unusually large produce of gold has been the result. The monthly returns have been as follows:—March (12 days) 18,634 oits.; April, 38,663 oits; May, 41,144 oits; June, 42,086 oits.; July, 45,106 oits.; August, 46,142 oits., September (18 days), 25,517 oits.: giving a total of 257,292 oits for 183 days. The produce for the six months immediately preceding the period now reported on (comprising 180 days) was 227,446 oits.; whilst that of March to September, 1860 (comprising 186 days), was 200,720 oits. The mean daily production of gold during these three half-yearly periods has thus been—

During the six months ending	September 18, 1861	1,406 oits per diem.
,, ,,	March 19, 1861	1,236 ,,
,, ,,	September 20, 1860	1,079 ,,

The profit on the working of the mines for the past half-year, as shown by the company's books in London, has been £41,978. 11*s*. 5*d*., adding thereto the amount received for interest on moneys unemployed, and deducting income tax and London expenses, there remains a net profit of £40,530. 13*s*. 9*d*., out of which the directors beg to recommend to the meeting the declaration of a dividend at the rate of 60*s*. per share, free of income tax. The amount of 10 per cent. thereon will be added, as usual, to the reserved fund. This proposition, after some discussion, was adopted by the meeting.

The quantity of stone raised from the mine during the half-year was 48,756 tons, against 47,087 tons in the preceding six months. The quantity of stone stamped during the half-year was 35,949 tons, against 35,341 tons in the preceding six months. The quantity of stone rejected during the half-year was 12,460 tons, against 11,259 tons in the preceding six months. The yield of gold per ton of stone during the six months has been as follows:—

	Tons.	Oits. per ton.
On the whole quantity raised	48,756	5·276
,, ,, stamped	35,949	7·157

During the preceding six months the yield was—

	Tons.	Oits. per ton.
On the whole quantity raised	47,087	4·830
,, ,, stamped	35,321	6·439

showing an increased yield of over 4-10ths of an oitava per ton of ore raised, and about 7-10ths of an oitava per ton of ore stamped.

The following is the financial position of the Company at the close of the half-year, on November 30:—

IN ENGLAND.

	£	s.	d.			
Balance at the bankers	2,371	10	3			
In deposit with London Joint-Stock Bank	54,000	0	0=£56,371	10	3	
To Pay: Draft running (due December 15)	55	0	0			
Income tax on last year's profits	2,277	3	7			
Dividend now proposed	33,000	0	0			
To reserved fund thereon 10 per cent	3,300	0	0= 38,632	3	7	

IN BRAZIL.

On dispatch of advices of September 28, from Morro Velho, and October 8, from Rio:—

Cash at Morro Velho	Rs. 36,984=$433
In transit to Morro Velho	15,000=$000
Cash at Rio	40,245=$340=Rs. 92,229=$773

Which, at the exchange of 2*s*. 1¼*d*. per real, is equal to £9,703. 6*s*. 9*d*., to meet the expenditure of September and October—(say) £18,000.

At the PACHUCA SILVER MINE (annual) meeting, on December 16, Mr. G. F. Smith (the secretary) read the advertisement convening the meeting. The report of the directors congratulated the shareholders upon the satisfactory manner which the prosecution of the works had been carried on at Pachuca, by Capt. Paull.

During the year, San Juan shaft, below San Juan level, had been sunk and secured nine varas; the adit level east of shaft had been driven 90 varas; the San Juan level, east of shaft, had been driven 93 varas, and Las Animas winze had been sunk 12 varas. The Tapona lode, in the adit level, is 12 feet wide, very promising, and producing good stones of ore, some assaying over 112 ounces of silver to the ton. It was expected that in a very short period the junction of the Tapona with the Vizcaina would be reached. The Tapona lode in the San Juan level also presented every appearance of a rich lode, and as that level was 20 varas deeper than the adit, it was expected that metal of a good ley would be found on arriving at the junction. At the bottom of the San Juan shaft stones of ore had recently been obtained which assayed 929 ounces of silver to the ton. In accordance with the resolution passed at the last general meeting, the directors had secured for the company the valuable sett of San Luis Mine, which adjoined, and was held upon the same terms as the Santa Elena Mine. Some very promising stones of ore had been found in the lode leading towards the great Vizcaina vein. From the results in the working, and the indications presented at both mines, the directors believe that the time was speedily arriving when they would have the further pleasure of congratulating the shareholders upon the complete success of the undertaking. In order to show the value of the properties, and the high estimation in which they were held by mining men in the neighbourhood, the directors might mention that since the formation of the present company parties had taken up and were working the ground both to the east and west of these mines.

The balance-sheet, made up to the end of October, showed that the cost incurred in working the Santa Elena Mine during the year amounted to £1,610. 0*s*. 7*d*.; and the sum expended upon the works in the San Luis Mine amounted to £268. 7*s*. 5*d*. In the bankers' hands in London there was cash amounting to £1,693; and in Mexico to £746.

At the Central American Mining Company meeting, on December 18, Mr. John Phillips (the secretary) read the report of the directors, which was of a very favourable character, fully confirming the high opinion which has been entertained of the value of the mine. The returns for the twelve months ending August was £21,401, whilst the aggregate expenditure had been £21,703, which showed a slight excess of cost over returns. The cost, however, included salt, quicksilver, and other stores. Again, there would be observed in the accounts the item premium on silver coin, an item which would probably not occur again, as the Company were now sending silver to the mint at Guatemala and receiving coin in exchange. The directors saw reason to think that the time was not far distant when they would be able to set aside a fund for distribution amongst the shareholders. Upon the conclusion of his term of agreement Mr. Ellery had returned to England, but a fresh arrangement had been entered into with him, and he would be back in January.

The following dividends have been declared during December:—

West Wheal Seton	£8	0	0	£3,200	0	0
Dolcoath	8	0	0	2,864	0	0
Great South Tolgus	0	5	0	1,500	0	0
North Downs	0	5	0	1,500	0	0
Tincroft	0	5	0	1,500	0	0
Wheal Basset	2	0	0	1,024	0	0
Mount Pleasant	1	5	0	800	0	0
Bedford United	0	3	0	600	0	0
Wheal Seton	1	10	0	594	0	0
Wheal Mary Ann	0	10	0	512	0	0
Orsedd	0	1	3	320	0	0
Boscean	1	5	0	300	0	0
St John del Rey	3	0	0	33,000	0	0
Total				£47,714	0	0

Prices Current of Metals.

					Per Ton.				
IRON	Bars	in Wales	£5	2	6	@	£5	5	0
	,,	,, Liverpool	......				5	15	0
	,,	,, London	6	0	0	,,	6	5	0
	Nail Rods	,, Wales	5	12	6	,,	5	15	0
	,,	,, Liverpool	6	10	0	,,	7	5	0
	,,	,, London	7	5	0	,,	7	15	0
	Hoops (Staffordshire)	,, Liverpool	7	15	0	,,	8	10	0
	,, ,,	,, London	8	5	0	,,	8	15	0
	Sheets ,,	,, Liverpool	8	10	0	,,	9	5	0
	,, ,,	,, London	9	0	0	,,	9	15	0
	Bars ,,	,, Liverpool	7	0	0	,,	8	0	0
	,, ,,	,, London	7	10	0	,,	8	10	0
	Scotch Pig (No.1.g.m.b.)	the Clyde	2	9	0	,,	2	10	0
	Rails	in Wales.	5	0	0	,,	5	5	0
	Russian	C.C.N.D	16	0	0	,,	16	10	0
	Swedish—Hammered—large sizes		11	10	0	,,	11	15	0
	,, ,, Indian sizes		11	10	0	,,	11	15	0
STEEL	Hammered—faggot		......				16	10	0
	,, in kegs ½ and ⅝ in.		......				15	10	0
COPPER	Australian and other *fine* Foreign		104	0	0	,,	107	0	0
	Foreign Slab, for Prod. 96 per Cent.		93	0	0	,,	94	0	0
	English Tile and Tough		105	0	0	,,	107	10	0
	,, Best selected		108	0	0	,,	110	10	0
					Per lb.				
	,, Sheets, Sheathing and Rod		11¾*d.*			,,	12*d.*		
	,, Flat Bottoms		12¼*d.*			,,	12½*d.*		
YELLOW METAL	Sheets, Sheathing and Rod		9½*d.*			,,	10*d.*		
					Per Cwt.				
TIN English	Common Blocks and Ingots		......				120*s.*		
	,, Bars (in barrels)		......				121*s.*		
	Refined		......				122*s.*		
Foreign	Straits		118*s.*			,,	120*s.*		
	Banca		......				121*s.*		
					Per Box.				
TIN PLATES at Liverpool 6d. Less.	Charcoal IC		28*s.*			,,	29*s.*		
	,, IX		34*s.*			,,	35*s.*		
	Coke IC		22*s.*6*d.*			,,	23*s.*		
	,, IX		28*s.*6*d.*			,,	29*s.*		
					Per Ton.				
LEAD	Sheet		......				20	10	0
	Pig—W.B.		......				21	10	0
	,, ordinary brands		......				20	5	0
	,, Foreign, soft		......				19	15	0
	Red		......				21	10	0
	Shot		......				23	0	0
	Dry White		......				27	0	0
SPELTER	(Cake)		£17	0	0	,,	17	5	0
ZINC	(Sheet)		......				24	0	0
					Per Bottle.				
QUICKSILVER	(in bottles containing 75 lbs. each)		......				7	0	0
					Per Ton.				
REGULUS OF ANTIMONY, French Star			......				47	0	0

Quotations mostly nominal.

Metal Markets.

THE following is condensed from the very excellent Review on the metal market for the past year, which appeared in the last issue of the *Mining Journal.*

The expectations so generally entertained at the expiratibn of 1860 that the present year would prove to be commercially a most prosperous one have certainly not been realised.

IRON.—The dulness of trade during the year has been felt very severely by the ironmasters, and for the most part their selling prices are stated to be less than the cost of production; this is more particularly the case in railway and merchant bars. For rails the demand has been extremely limited. One of the greatest outlets for this description of iron was America, whose immense lines have helped to keep our manufacturers well employed for several years past, and now the falling off, on account of the prohibitive duty levied, has caused great depression. Prices of rails have undergone but slight fluctuations, only varying from £4. 17*s.* 6*d.* to £5. 5*s.* at the works. The higher rate was barely maintained at any period.

Merchant bars from £6. 10*s.* in January fell to £5. 15*s.* in July and August; since, a slight improvement has been maintained, and £5. 17*s.* 6*d.* to £6 is now quoted, f.o.b. in London. North of England bars can be bought in quantities at £5. 15*s.* Staffordshire makers have been obliged during several months to work short time, and at the half-yearly meeting a fixed reduction of 10*s.* per ton in price was agreed upon. Swede bars in the early part of the year were tolerably active at £11. 5*s.* to £11. 10*s.*, but decreased in value some 12 or 13 per cent. about July. Scotch pigs, in proportion with the price of manufactured iron, have ruled high. In January mixed numbers were quoted at 49*s.*; March, 47*s.* 6*d.*; August, 51*s.* 9*d.*, declining again to 48*s.* 3*d.*, on account of the American affair. The last day or two there is a slight recovery, sellers quoting 48*s.* 7½*d.* to 48*s.* 9*d.* cash, mixed numbers.

STEEL.—The demand for English descriptions has been limited. In Swedish keg, excessive stagnation marked the trade for the first nine months of the year, and the price has fallen considerably below the average of the last 10 years,

COPPER.—The business transacted during the year in English descriptions has been extensive; but anything but remunerative to the smelters, the standard by which they purchased ores having been proportionately high above the price of the manufactured article; they have been obliged, and in many cases, to take contracts on terms resulting in possitive loss to themselves. The fixed price of sheets, sheathing and bolts was, during January, February and the greater part of March, 11½*d.* per lb.; but, as the demand gradually decreased and underselling became the rule, a reduction of ½*d.* per lb. was submitted to; this price (11*d.*) remained with a fair enquiry up to about the middle of May, when the market became dull, and several second-hand lots were offering under price. On the 24th June a further reduction of ½*d.* per lb. took place, making quotations 10½*d.* per lb. for manufactured and £93 for cake and tile; but difficulty was experienced in realising at even ½*d.* under this price, a very large quantity being held in second hands. For nearly ten years previously so low a figure had not been touched. Eventually a better feeling was manifested, and a good enquiry sprung up. The standard of ores advanced steadily at each successive ticketing; but not until the middle of August was any advance made in fixed rates, and then only ½*d.* per lb. This, however, had the effect of increasing the demand. A large business was done, and prices were well maintained up to about the middle of October, when a falling off was visible, and much less activity prevailed; just then, very unexpectedly, the smelters announced a further rise of £5 per ton. This was done apparently only to keep pace with the rising standard, as copper was but in limited request at that time. An improvement in the demand for India caused a further rise to 12*d.* on the 25th of November, since which parcels in second hands have been offering under price, and our market, owing to the American difficulty, closes in a nominal state. Burra Burra has varied from £92 to £104 per ton, lowest prices ruling in July and advancing with English. Kapunda has sold freely, value closely approximating to Burra. Chili has been bought largely, and the stocks much diminished, owing to the supplies this year being considerably under last year's importations. Prices have varied from £82 to £94. Several parcels of Spanish, of various brands, have arrived and met with ready sale, quotations varying from £82 to £93. Large quantities of Baltimore have been shipped from America to this country and the Continent, which has operated most

unfavourably upon this as well as upon the continental markets. Orders lately have been received for the whole quantity remaining in first hands to be returned, and some shipments have already been made.

TIN.—For more than two years past this metal has been on the decline, until the last three or four months, when a decided reaction set in, and prices once more assumed an upward tendency, which, however, at the present unfortunate juncture shared the fate of all other metals. Quotations for English declined in the first part of the year, January to August, from £132 to £114, at which price they began to improve. In foreign the deliveries of Banca have been very large, and the supplies for the ensuing year are expected to be rather short of 1861. Prices have varied about £16 per ton, In straits arrivals are much larger this year than hitherto, and, judging from stocks, the market is not very promising. It is, however, chiefly held in strong hands, and therefore is not likely to be sacrificed. Last business reported £118.

LEAD.—During the year prices of this metal have reached a lower point than for the last ten years. Early in this year the exports of English pig, especially to China, were large, and prices maintained with firmness at £21. 5*s*. This demand falling off the market declined to September (lowest point £18. 15*s*.), when the demand began to improve, and sellers held for higher rates. A comparatively large business was about this time transacted, and £20 is now quoted. Sheet, shot, and other descriptions have been but slightly in request all through the year. The imports of Spanish pig have been large, and prices ruling in proportion to English. German, of soft quality and known brands, disposed of freely at £18. 10*s*. to £19. The demand in Germany for direct shipments to America, however, maintains prices beyond present quotations of English.

SPELTER.—Prices during this year have reached a lower minimum than since 1852—viz., £16. In 1857 the quotation advanced to £30. 17*s*. 6*d*., or very nearly double. Large quantities have at different periods changed hands; these sales, however, have been entirely on speculation—deferred prompts, distant arrivals, &c., being used to create a species of time bargaining. The American news has depreciated the value of spelter 30*s*. or 40*s*. per ton, equal to 10 per cent. The present stocks held in London amount to upwards of 5000 tons, and are still increasing.

Metallic-Ore Markets.

TIN.—At the beginning of the month, the standards for black tin were :—

Refined ... £114

Common ... 109, and, from the buoyancy of the market, a rise was daily expected. The *Trent* affair, however, altered all this; and, instead of a rise, we have had a fall during the last week of the month of £2, the standards being now quoted at—

Refined ... £112

Common ... 107. This drop, which makes a total of £5 since June, will be severely felt by the Cornish tin mines.

COPPER.—At the four Cornish sales of the month, the average produce price per ton, and standard, have been as follows :—

		Produce.		*Price per Ton.*	*Standard.*
Dec. 5	...	6¼	...	£5 14 0	£136 2 0
„ 12	...	6½	...	5 9 6	132 12 0
„ 19	...	5⅜	...	4 11 6	135 12 0
„ 26	...	5¾	...	4 16 0	132 7 0

We have already (see note, page 28) expressed our opinion as to the entire uselessness of the standard, as even indicating how the prices of ores have gone, which we may instance by taking the average standards of the sales of the 12th and 19th, which show a nominal advance of £3,—whereas there has actually been no advance in the prices of the ores. Consequently, to find how these prices have really gone, a supplementary calculation is made. A good deal of misapplied ingenuity has been expended on this

subject, but, it would seem, to no good purpose, for the adepts in calculating this "supplementary standard" differ very widely—which is not very much to be wondered at. For instance: let us take the above sales: in calculating the "supplementary standard" of the sale of the 5th, compared with that of the previous week, the *Mining Journal* makes out that it has remained stationary, while, according to the *West Briton*, it fell 21*s*. In the sale of the 12th again, according to the *Mining Journal*, the decline was £2, while the *West Briton* makes it £3. 9*s*. Similarly as to the standard of the sale of the 19th, the *Journal* makes the decline £1. 10*s*., and the *West Briton* £2. 3*s*.; while, in that of the 26th, the former makes the fall £1. 10*s*., and the latter only 6*s*.

We have not the least intention of following either of these authorities into their calculations; they each have their partisans, who are satisfied with their respective conclusions. As will be seen from the explanation extracted from Dr. Percy's "Metallurgy," the copper standard is at present a mere myth, and we have no confidence in any calculation founded on such a basis. Besides, the whole affair is a work of the most complete supererogation. The common-sense fact, that ores averaging such and such a produce realized an average price of so much per ton, is mystified by calculating an imaginary standard, which, as it stands, admittedly conveys no distinct idea; and a supplementary calculation is instituted to bring this back to common sense again—that is, to the point started from before calculating the standard—by a muddling calculation which necessarily results in confusion.

The real object of all this arithmetical circumlocution—the comparison of the prices realised by ores at different sales according to their produce—is easily arrived at, without any of this confusion or complication, by comparing the average produces and average prices realised at each sale. Of course, a slight allowance must be made according to what the produces are; but this is the only common-sense method of proceeding, and is comprehensible in a moment to every one who can do a rule of three sum. We cannot enter into the matter further this month, but a glance at the average produces and prices per ton given above, shows that a heavy fall took place between the first and second sale of the month, and a slight decline subsequently.

In the Swansea copper ore circular no average standard is calculated, nor is the average produce either. The abandonment of the standard here is the best evidence of the estimation in which it is held by those most capable of judging. The produces of the ores sold at Swansea differ so widely that in their case a calculated average produce is of no value, particularly as the produce of each parcel is given in the circular, which is not done in the Cornish ticketing paper. A comparison of the prices realised by ores of a similar or nearly similar produce, at the Swansea sales of the 10th and 24th, shows at once a fall in prices between these two sales.

Lead.—The fall in the prices of lead ores still continues; a comparison between the latest sales of November and December showing a further decline of from 10*s*. to 15*s*. per ton of ore. This is becoming very serious for the lead mining districts, and must be severely felt in large-producing mines.

Copper Ores,

Sampled Nov. 20. and sold at Tabb's Hotel, Redruth, Dec. 5.

Mines.	Tons.	Purchasers.	Price.		
Clifford Amalgamated	113	3	£6	9	6
(Wheal Clifford)	112	4	6	8	0
	110	7	6	11	0
	105	2, 7	6	9	0
	95	2	4	14	6
	84	2	4	6	6
	83	3	15	18	6
	74	7	5	17	0
	72	7	3	14	0
	71	4	7	19	0
	47	4	7	7	0
	19	2	4	12	6
Engine ore.........	62	2, 7	8	1	0
West Seton..................	91	8	5	9	0
	90	4	7	7	6
	88	4, 8	10	0	0
	80	10	8	16	6
	69	4	8	11	6
	68	4	6	16	6
	61	8	2	19	6
	53	14	2	18	0
	41	8	6	12	0
Tincroft	80	2	1	1	6
	60	10	2	19	6
	58	10	2	16	0
	57	10	5	7	0
	56	10	5	7	6
	46	14	3	4	6
	29	2	11	10	6
	20	10, 11	2	3	6
East Pool	75	14	4	13	0
	62	9	3	10	0
	57	14	3	14	6
	55	8	4	15	0
	40	2	0	12	6
	37	5, 7, 8	5	0	0
	28	9	4	3	6
	20	14	2	6	0
Wheal Basset	99	6	6	16	0
	82	8	6	19	6
	80	7	9	15	0
	57	6	5	10	0
	26	11, 14	2	3	0
Wheal Basset	20	6	£16	2	0
Wheal Seton	69	11	1	6	6
(Pendarves)	67	8	5	11	6
	60	8	6	7	0
	42	7	6	17	0
	38	8	5	11	0
	30	11	2	14	6
	29	7	13	14	6
Condurrow..................	94	7	2	19	0
	65	7, 8	2	10	6
	50	3	6	2	0
	45	7	7	16	6
	28	9	0	7	6
	21	8	2	16	6
South Frances	91	6	5	7	6
	47	10	10	0	0
	45	7	5	7	6
	30	6	5	6	6
	7	14	3	14	0
South Tolgus	80	3, 7	11	1	0
	53	8	4	10	0
	50	11	4	9	6
East Bassett	76	2	5	3	6
	58	2, 6, 10	6	1	6
	27	2, 6	11	10	0
New Treleigh	61	9	3	10	0
	46	9	3	10	0
	28	7, 9	8	8	6
Camborne Vean	57	4	7	3	6
	54	14	2	4	6
	23	4	1	0	0
Stray Park..................	66	10	3	6	6
	35	9	0	10	0
	22	3	11	0	6
Dolcoath......................	41	10	5	0	6
	31	11	2	7	6
West Tolgus	63	8	4	16	0
South Crofty..............	25	2, 4	1	1	6
	20	10, 11	6	17	0
	13	9	2	19	6
South Basset...............	38	11	3	5	0
Carn Camborne	17	6	5	9	6
	5	2	1	13	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Clifford Amalgamated.........	1047	7,176	7	0
West Wheal Seton...............	641	4,407	5	0
Tincroft.............................	406	1,558	18	6
East Pool...........................	374	1,412	4	6
Wheal Basset......................	364	2,716	11	0
Wheal Seton	335	1,824	6	6
Condurrow	303	1,168	7	6
South Wheal Frances.........	220	1,386	13	0
South Wheal Tolgus...........	183	1,346	5	0
East Wheal Basset	161	1,056	3	0
New Treleigh	135	610	8	0
Camborne Vean..................	134	552	2	6
Stray Park........................	123	479	10	0
Dolcoath	72	279	13	0
West Wheal Tolgus............	63	302	8	0
South Wheal Crofty...........	58	202	11	0
South Wheal Basset...........	38	123	10	0
Carn Camborne..................	22	101	9	0

EACH COMPANY'S PURCHASE.

	Tons.	£	s.	d.
1 Mines Royal Co............	—	——		
2 Vivian and Sons............	557	2,621	5	3
3 Freeman and Co............	308	3,043	0	0
4 Pascoe Grenfell and Sons	593½	4,231	12	9
5 Crown Copper Co.........	12½	61	13	4
6 Sims, Willyams and Co..	347	2,323	7	0
7 Williams, Foster and Co.	763½	5,048	13	7
8 Mason and Elkington...	721	3,930	12	1
9 F. Bankart....................	287	893	0	6
10 Copper Miners' Co.........	504	2,756	0	6
11 C. Lambert..................	251	712	5	0
12 Newton, Keates & Co.....	—	——		
13 Alkali Co......................	—	——		
14 Sweetland Tuttle and Co	325	1,083	2	6
	4,679	£26,704	12	6

Average produce, 6¼.
Quantity of fine Copper, 290 tons 14 cwt.

Average standard, £136 2s. 0d.
Average price per ton £5 14s. 0d.

Copper Ores,

Sampled Nov. 27, and sold at Tabb's Hotel, Redruth, Dec. 12.

Mines.	Tons.	Purchasers.	Price.		
West Basset	88	6	£6	5	6
	82	10,11	4	2	6
	80	10	4	15	6
	75	10	6	4	6
	69	8	4	19	0
	68	8	5	5	0
	42	8	7	0	0
	32	6	5	1	6
	16	6	2	17	0
Carn Brea	122	2	0	4	6
	64	3,7	5	19	6
	58	6	6	16	0
	57	11	2	8	0
	55	14	3	9	6
	46	11	2	8	0
	44	3,7	5	1	0
	38	4	8	1	6
	37	11	4	15	0
Great Wheal Alfred......	67	8	4	0	6
	65	7,8	2	16	6
	60	8	2	19	6
	50	7	2	16	6
	43	2,7	3	0	6
	35	14	3	10	6
	24	8	1	12	0
	16	3	13	7	0
Par Consols	77	3	8	10	6
	73	6	10	19	6
	68	10	7	5	0
	35	14	4	0	0
Pendeen Consols.........	107	2	2	10	6
	55	2	3	6	6
	50	2	2	17	6
	3	2	25	10	0
Great South Tolgus ...	64	7	6	0	6
Great South Tolgus ...	63	4,7	9	15	6
	51	4	9	1	6
	35	4	9	11	0
Charlotte United	63	6	9	4	6
	46	6	8	14	6
	42	9	6	18	0
Rosewarne United	60	.7	7	15	6
	52	7	11	18	6
	37	6,7	4	13	0
Wheal Buller...............	57	10	3	4	0
	46	2	0	4	6
	29	8	10	8	6
Copper Hill	53	11	2	1	6
	45	8,11	5	10	6
	25	4	16	12	0
Wheal Anna	75	3	3	6	6
	28	6	1	13	6
Treloweth	46	10,11	7	7	6
	21	9	7	18	6
	20	8	14	14	6
Prideaux Wood............	60	9	2	18	6
Wheal Unity Consols ...	32	8	4	6	0
Mines Royal Co.'s Ore	25	11	4	13	6
	3	6	3	19	0
Pend-an-drea	16	11	3	11	0
	7	8	12	19	6
Rosewarne Consols......	11	8	7	4	0
	3	6,14	0	17	6
Trevoole	12	8	3	1	6
Boscaswell Downs	12	2,6	14	0	6
South Dolcoath	12	2,6	18	10	6
Camborne Consols	10	6	7	2	0
Wheal Grylls..............	7	2	3	15	0
Goonzion	4	6	8	16	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
West Basset	552	£2,939	17	6
Carn Brea........................	521	1,947	7	6
Great Wheal Afred............	360	1,278	10	0
Par Consols	253	2,090	12	0
Pendeen Consols...............	215	673	6	0
Great South Tolgus	213	1,798	10	0
Charlotte United..............	151	1,272	6	6
Rosewarne United	149	1,258	13	0
Wheal Buller	132	495	1	6
Copper Hill	123	773	12	0
Wheal Anna......................	103	296	5	6
Treloweth........................	87	800	3	6
Prideaux Wood	60	175	10	0
Wheal Unity Consols	32	137	12	0
Mines Royal Ore..............	28	128	14	6
Pend-an-drea	23	147	12	6
Rosewarne Consols	14	81	16	6
Trevoole	12	36	18	0
Boscaswell Downs...........	12	168	6	0
South Dolcoath	12	222	6	0
Camborne Consols............	10	71	0	0
Wheal Grylls	7	26	5	0
Goonzion	4	35	6	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Mines Royal	—	——		
2 Vivian and Sons	423½	997	13	9
3 Freeman and Co.	222	1,421	14	0
4 Grenfell and Sons	180½	1,826	16	9
5 Crown Copper Company	—	——		
6 Sims, Willyams and Co.	453	3,385	19	9
7 Williams, Foster & Co.	384	2,466	10	9
8 Mason and Elkington...	496	3,636	12	0
9 F. Bankart	123	631	14	6
10 Copper Miners' Compy.	344	1,863	0	6
11 Charles Lambert	320½	1,169	13	3
12 Newton, Keates and Co.	—	——		
13 Alkali Company	—	——		
14 Sweetland and Co.	126½	455	16	3
	3073	£16,855	11	6

Average produce, 6¼.
Quantity of fine Copper, 190 tons 16 cwts.

Average standard, £132 12s. 0d.
Average price per ton, £5 9s. 6d.

Copper Ores,

Sampled Dec. 4, and sold at the Royal Hotel, Truro, Dec. 19.

Mines	Tons.	Purchasers.	Price.
Devon Great Consols...	135	6	£4 9 6
	125	6	10 16 0
	118	10	4 16 0
	117	3	5 4 6
	114	7	4 2 6
	109	6,11	4 12 6
	108	14	2 12 6
	105	10	3 12 6
	102	10,11	4 5 0
	100	9	5 6 0
	99	7	10 9 6
	97	11	4 16 6
	94	11	3 13 6
	93	6,11	2 6 0
	92	11	3 13 6
	90	11	4 15 0
	85	11	1 7 6
	74	3	2 13 0
	69	8	3 8 0
	68	14	2 4 0
	63	7	7 14 6
	48	6	0 15 0
	42	14	4 6 6
Phœnix Mines	93	2	4 3 6
	92	8	4 6 6
	87	6	4 7 0
	86	6	6 13 0
	77	8	6 7 6
	50	7	8 2 6
	30	8	5 5 0
	25	14	4 6 0
	14	6	4 6 0
	10	2,6	6 10 6
Marke Valley	112	14	3 9 6
	100	9	4 1 6
	70	7	4 10 6
	68	7	4 4 0
	50	9	3 13 6
Wheal Crelake...........	75	5,7	2 18 6
	74	5,7	4 7 6
	70	5,7	2 17 6
	57	3	7 7 0
	48	10	7 5 6
	46	7	4 17 0
Great Wheal Martha ...	120	2,6	2 15 0
Great Wheal Martha ...	75	2,6	1 12 0
	57	2,6	2 17 0
	54	2,6	4 15 0
	44	2,6,13	1 6 6
East Caradon..............	93	11	4 12 6
	75	11	3 17 6
	64	6	9 16 6
	63	3	7 10 0
	50	11	5 3 0
Wheal Edward...........	70	5,7	2 15 0
	68	10	3 17 6
	66	5,7	3 7 6
	38	10	2 11 0
	32	10	2 6 6
Bedford United...........	109	5,7,8	4 4 6
	95	6	3 13 6
North Wheal Robert ...	92	14	2 6 6
	75	8	10 7 0
	37	14	5 18 6
Wheal Emma	82	9	2 16 6
	52	3	6 0 0
	26	5,7	2 8 6
Calstock Consols	70	5,7	3 18 0
	69	5,7	4 8 6
	20	5,7	1 7 6
Wheal Yarner......	113	2	2 13 0
	41	2	4 17 6
Sortridge Consols	68	8,10	10 5 0
	62	10	7 3 6
Wheal Friendship	68	5,7	8 16 6
	43	5,7	10 14 6
Wheal Arthur	59	5,7,8	3 5 0
	35	5,7	5 14 0
	16	8	2 15 0
Okel Tor....................	70	3	3 0 6
	40	6	2 4 6
Brookwood	55	10	4 14 6
	7	10	6 6 6
Devon and Cornwall ...	50	6	2 5 6
Lady Bertha	32	6	1 13 0
Hawkmoor..................	30	5,7	4 9 6
Fursdon	29	6	6 2 0
Trehill........................	25	6	2 5 0
Nanjiles	10	4	6 12 0
Furze Park Ore	9	10	3 18 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2147	£9965 7 0
Phœnix Mines.................	564	3024 2 0
Marke Valley..................	400	1582 16 0
Crelake...........................	370	1735 12 6
Great Wheal Martha.........	350	927 5 0
East Caradon..................	345	2079 11 0
Wheal Edward................	274	850 1 0
Bedford United...............	204	809 13 0
North Robert..................	204	1209 7 6
Wheal Emma..................	160	606 14 0
Calstock Consols.............	159	605 16 6
Wheal Yarner..................	154	499 6 6
Sortridge Consols...........	130	£1141 17 0
Wheal Friendship...........	111	1061 5 6
Wheal Arthur.................	110	435 5 0
Okel Tor..........................	110	300 15 0
Brookwood......................	62	304 3 0
Devon and Cornwall.........	50	113 15 0
Lady Bertha.....................	32	52 16 0
Hawkmoor.......................	30	134 5 0
Fursdon...........................	29	176 18 0
Trehill.............................	25	56 5 0
Nanjiles...........................	10	66 0 0
Furze Park Ore................	9	35 6 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Mines Royal	—	£ ——
2 Vivian and Sons.............	419⅔	1374 2 8
3 Freeman and Co.............	433	2222 12 6
4 Grenfell and Sons...........	10	66 0 0
5 Crown Copper Co...........	414	1829 3 9
6 Sims, Willyams & Co.......	1103⅝	5312 16 11
7 Williams, Foster & Co....	924	5054 16 9
8 Mason and Elkington....	449	£2667 1 0
9 F. Bankart....................	332	1352 18 0
10 Copper Miners' Co........	627	3080 12 0
11 Charles Lambert...........	828	3249 19 3
12 Newton, Keates & Co....	—	——
13 Alkali Co. (Limited)......	14⅓	19 8 8
14 Sweetland and Co.........	484	1544 11 6
Total...........	6039	£27,774 3 0

Average Produce, 5⅝.
Quantity of Fine Copper, 327 tons 5 cwts.

Average Standard, £135 12 0.
Average Price per ton, £4 11 6.

Copper Ores,

Sampled Dec. 11, and sold at Tabb's Hotel, Redruth, Dec. 26.

Mines.	Tons.	Purchasers.	Price.
Great Wheal Busy	82	8	£2 9 0
	78	11	2 3 0
	66	8	2 0 6
	64	10	2 8 0
	62	6	2 9 0
	58	10	3 9 6
	56	8	3 2 0
	53	11	1 5 0
	46	14	2 2 0
	39	9	2 8 6
	36	9	3 1 0
Fowey Consols	100	2, 6	5 10 6
	98	2	5 13 0
	81	2, 6	6 12 6
	78	2	6 14 6
	63	2, 6	6 8 0
	60	6	3 1 6
South Caradon	105	8	6 1 0
	83	8	6 5 6
	81	7	9 8 0
	52	7, 8	9 1 0
	51	4, 6, 7	16 14 6
	39	2, 6, 7	17 9 6
	36	6	1 9 6
	23	4	6 10 6
Clifford Amalgamated (United Mines)	75	3, 7, 8	4 5 0
	74	3	2 12 0
	40	11	0 16 6
	37	14	0 17 6
	33	4, 7, 8	5 15 0
Clifford Amalgamated	25	4, 11, 14	£2 5 6
	20	3	0 5 6
	16	14	2 13 0
West Damsel	62	5, 7	4 13 6
	58	5, 7	4 7 6
	54	5, 7	5 1 6
	48	8	4 14 6
	42	9	3 14 6
	36	3	1 15 0
Tywarnhaile	47	4	4 5 0
	46	9	2 19 6
	45	14	2 0 6
	42	14	2 10 6
	40	8	2 10 6
	34	8	4 1 0
	16	4	3 17 0
South Crinnis	72	2	4 11 6
	68	3, 7	3 14 0
	32	3, 7	6 18 0
Craddock Moor	50	4	10 7 6
	42	4, 10	7 14 0
North Grambler	41	8	6 0 0
	39	8	7 17 6
Gonamena	29	11	6 6 0
	17	14	3 1 6
Grambler & St. Aubyn	33	7	7 18 6
Cuddra	30	9	3 14 6
Trenouth's Ore	30	6	1 13 6
East Tolgus	22	7	4 2 0
Creegbrawse	16	6	4 4 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount. £. s. d.
Great Wheal Busy	640	1,550 2 6
Fowey Consols	480	2,755 1 6
South Caradon	470	4,125 15 0
Clifford Amalgamated	320	871 1 0
West Damsel	300	1,263 18 0
Tywarnhaile	270	834 1 6
South Crinnis	172	801 16 0
Craddock Moor	92	842 3 0
North Grambler	80	553 2 6
Gonamena	46	234 19 6
Grambler and St, Aubyn	33	261 10 6
Cuddra	30	111 15 0
Trenouth's Ore	30	50 5 0
East Tolgus	22	90 4 0
Creegbrawse	16	67 12 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
2 Vivian and Sons	383	£2380 19 9
3 Freeman and Co.	205	603 7 0
4 Grenfell and Sons	193½	1458 8 2
5 Crown Copper Co.	87	408 16 6
6 Sims, Willyams & Co.	356	1765 0 3
7 Williams, Foster & Co.	365	2674 9 0
8 Mason and Elkington	656	3087 13 0
9 F. Bankart.	193	609 8 6
10 Copper Miners' Co.	143	517 16 0
11 Charles Lambert	208½	468 12 2
12 Newton, Keates & Co.	—	—
13 Alkali Co	—	—
14 Sweetland & Co.	211½	439 15 8
	3001	£14,413 7 0

Average Produce, 5¼
Quantity of Fine Copper, 171 tons 5 cwt.

Average Standard, £132 7 0.
Average Price per ton, £4 16 0

Copper Ores,

Sampled Nov. 20, and sold at Swansea, Dec. 10.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	96	12	7	£11 12 0	Berehaven	106	11½	10	£11 2 6
	93	12	6,7	11 11 0		100	11⅝	1	11 2 6
	82	12½	6	11 14 0		114	9⅞	6	9 10 0
	8	14¾	6	14 4 0	Ballycummisk	60	12⅝	7	12 7 6
	90	12⅞	3	11 17 6		48	5	12	4 11 6
	66	12½	8	11 14 6		16	4½	12	3 17 6
	58	19⅞	7	18 17 0	Laxey	112	5½	7	4 19 0
	7	64½	6	60 0 0	West Kaime ...	16	5½	6	5 6 0
Knockmahon ...	93	13½	1	13 5 6	Turkish	13	17	2	16 11 6
	59	10¾	6	10 14 0	Connoree Precipitate	9	42	5	40 10 0
	57	11¾	2	11 9 6	Cronebane	3	23	5	21 5 0
	71	10⅞	6,7	10 11 0	Tigrony	3	23	5	21 5 0
	70	10⅞	2	10 5 6					

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
Cobre	500	£6,616 13 0	West Kaime	16	£84 16 0
Knockmahon	350	3,988 5 0	Turkish	13	215 9 6
Berehaven	320	3,374 15 0	Connorree Precipitate	9	364 10 0
Ballycummisk	124	1,024 2 0	Cronebane	3	63 15 0
Laxey	112	554 8 0	Tigrony	3	63 15 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Copper Miners' Comp...	193	£2,347 1 6	7 Williams, Foster & Co...	408	£4,415 8 0
2 Freeman and Co.	140	1,588 16 0	8 Mines Royal Company	66	773 17 0
3 P. Grenfell and Sons ...	90	1,068 15 0	10 Mason and Elkington ...	106	1,179 5 0
5 Sims, Willyams and Co.	15	492 0 0	12 C. Lambert	64	281 12 0
6 Vivian and Sons	368	4,203 14 0		1,450	£16,350 8 6

Copper Ores,

Sampled December 4th, and Sold at Swansea, December 24th.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	96	12¾	7	£11 12 0	Knockmahon..	82	12⅛	2,6	£11 19 0
	94	12¾	1,7	11 12 0		59	13¼	6	13 0 0
	93	13⅜	7	11 12 6	Berehaven	118	10⅜	6	9 19 0
	92	13	3	11 12 0	Ookip	50	32⅜	1	31 5 0
	48	22½	1	20 16 0		46	33	1	31 14 6
	45	22⅝	1	20 7 0	Lochwinnoch..	49	5⅝	6	4 16 0
	11	64⅜	5	57 8 0		27	4¼	6	4 4 0
	10	64½	5	59 7 0		5	9⅜	6	8 15 0
	95	13¼	2	11 17 6	AustralianReg.	8	53	6	51 0 0
	90	13	6,7	11 19 0		1	53⅛	6	51 0 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
Cobre	654	£9695 16 0	Ookip	96	£3021 17 0
Knockmahon	141	1746 18 0	Lochwinnoch	81	392 7 0
Berehaven	118	1174 2 0	Australian Regulus	9	459 0 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Copper Miners' Co.......	236	£5482 8 0	5 Sims, Willyams & Co.	21	£1224 10 0
2 Freeman and Co.........	136	1618 1 6	6 Vivian and Sons.........	353	3820 3 0
3 P. Grenfell and Sons...	92	1067 4 0	7 Williams, Foster & Co.	281	3277 13 6
			Total...........	1119	£16,490 0 0

Black Tin Sales.

Date.	Mines.	Tons	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Nov. 30.	St. Day United......	22	10	0	15	62	0	0	Trethellan	2392	18	11
	,, ...	16	1	3	4	62	0	0	Mellanear...........			
	Great Wheal Busy	7	4	2	22	63	0	0	Carvedras...........			
	,,	0	8	3	1	45	0	0	ditto			
Dec. 3.	,,	7	7	3	8	63	0	0	ditto	1039	12	1
	,,	0	16	2	1	60	10	0	ditto			
	,,	1	1	2	8	45	0	0	ditto			
,, 10.	Wendron Consols	13	2	3	13		—		Union	912	13	3
,, 13.	Penhale Moor	1	7	3	25		—		—	102	6	7
,, 14.	Great Work	9	4	1	24	76	5	0	—	703	5	4
,, ,,	Wheal Kitty	4	8	1	22	64	10	0	Treriffe	598	3	7
,, ,,	,,	4	18	0	20	63	15	0	Trethellan			
,, ,,	Penhalls	2	13	2	23	68	7	6	Trethellan	364	5	6
,, ,,	,,	2	13	0	0	68	10	0	Treriffe			
,, ,,	Great Wheal Vor ...	21	16	3	4		—		—	1612	5	0
,, 16.	Gt. Wheal Fortune	22	18	3	2		—		—	1726	10	6
,, 17.	Brea Consols	3	10	3	15	74	7	6	Mitchell & Co.......	342	9	7
	,,	1	7	0	24		—		ditto			
,, 19.	Tincroft	9	7	1	14	67	5	0	Bolitho & Sons ...	1533	17	0
,, 21.	,,	2	17	3	1	73	0	0	ditto			
,, 23.	,,	10	6	0	11	67	15	0	Harvey & Co.			
,, 21.	South Carn Brea ...	7	17	2	14	66	15	0	Carvedras..............	526	1	5
	W. Fowey Consols.	17	16	2	5	68	0	0	ditto	1212	5	0
,, 23.	Bottle Hill	2	17	3	20	68	15	0	Charlestown	296	8	7
	,, ...	0	2	0	23	50	0	0	ditto			
	,, ...	1	5	2	17	68	15	0	ditto			
	,, ...	0	1	2	4	50	0	0	ditto			

Tin ores being sold by private contract, the particulars are not generally published or accessible. We hope, however, to be able to provide monthly a tolerably complete list of the sales of this metallic ore: the above list gives no idea of the real sales.

Sundry Copper Ore Sales.

Sold at Liverpool, by Mr. J. P. Campbell, ex *Marion*, from Quebec.

Date.		Tons.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Nov. 28.	Lot 1........................	84	14	12	6	Williams, Foster, & Co.	4126	10	0
	2........................	84	14	11	0	ditto			
	3........................	84	14	9	0	ditto			
	4........................	22	21	0	0	Sims, Willyams, & Co....			
Dec. 17.	Parys	175	5	12	0	ditto	980	0	0

Sold at Liverpool, by James Hallows, ex *Ilymane*.

Date.		Tons.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
,, 20.	Lot 2........................	73	22	6	6	Williams, Foster & Co.	9496	14	6
	3........................	73	22	0	0	Sweetland, Tuttle & Co.			
	4........................	73	22	0	0	ditto			
	5........................	70	22	5	0	ditto			
	6........................	70	22	5	0	ditto			
	7........................	70	22	0	0	ditto			

The Worthing Mining Company sold at the ore yard, Mellish's Wharf, Millwall, 20 tons of regulus, at £42 5*s*. per ton, and 20 tons of ditto, at £42 10*s*. per ton, realising together £1695.

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Nov. 26.	Wheal Mary Ann	60	25	7	6	Stock & Co.	1792	10	0
	,,	13¼	10	0	0	ditto			
	,,	13¼	10	0	0	Pontifex & Wood			
,, 28.	Westminster	55	12	8	6	Walker, Parker and Co.	683	7	6
	Maesysafn	100	12	10	0	Newton, Keates and Co.	1250	0	0
	Mount Pleasant	40	12	15	0	A. Eyton	510	0	0
	Hendre Ucha	14	12	18	0	Walker, Parker and Co.	180	12	0
	Garreg	3	12	8	6	ditto	37	5	6
	Tyndrum	45	11	1	0	ditto	652	17	6
	,,	15	10	7	6	Newton, Keates and Co.			
	Lochtayside	1	50	10	0	ditto	50	10	0
	Pool Park	15	12	13	0	A. Eyton	189	15	0
,, 30.	Minera	100	12	15	0	Newton, Keates & Co.	5885	0	0
	,,	100	12	18	6	Walker, Parker & Co.			
	,,	100	12	18	6	ditto			
	,,	100	12	16	0	Newton, Keates & Co.			
	,,	25	12	13	0	ditto			
	,,	25	12	13	0	Panther Company			
	,,	10	11	5	0	Walker, Parker & Co.			
Dec. 2.	Newtownards	75	12	12	0	A. Courage and Co.	945	0	0
	East Logylas	70	12	4	0	Sims, Willyams and Co.	854	0	0
	Glogfach	60	16	1	0	ditto	963	0	0
	Cwmystwith	60	13	0	0	ditto	1542	0	0
	,,	60	12	14	0	ditto			
	Goginan	41	16	13	0	ditto	819	18	0
	,,	9	15	5	0	Walker, Parker & Co.			
Dec. 5.	Tassan	25	12	4	6	A. Eyton	305	12	6
,, 7.	Penpompren	20	13	14	0	Sims, Willyams and Co.	274	0	0
	Brynarian	20	12	5	0	ditto	245	0	0
,, 9.	Dyliffe	51	12	18	6	A. Eyton	659	3	6
,, 10.	Carmarthen United	25½	13	3	0	ditto	335	6	6
,, 11.	Keswick	25	11	13	6	W. J. Cookson and Co.	291	17	6
,, 12.	Talargoch (Maesyrerwddu)	55½	13	0	6	Walker, Parker & Co.	1340	5	9
	Talargoch (Coetia Llys)	49	12	12	0	ditto			
	Deep Level	25	11	15	6	ditto	294	7	6
	Brynford Hall	10	12	8	0	A. Eyton	124	0	0
	Herward United	14	11	7	6	Newton, Keates and Co.	159	5	0
	Speedwell	6	11	16	6	Walker, Parker and Co.	70	19	0
	Rhosesmor	60	12	15	0	A. Eyton	1525	10	0
	,,	60	12	13	6	Walker, Parker & Co.			
	Orsedd	15	12	8	6	ditto	186	7	6
	Tymaen	4	13	1	6	ditto	52	6	0
	Parry's Mine	30	12	11	6	ditto	377	5	0
	Bryn Gwiog	45	12	12	0	A. Eyton	567	0	0
	Long Rake	10	12	1	6	Walker, Parker and Co.	120	15	0
	Lady Eleanor	3	12	14	0	Newton, Keates and Co.	38	2	0
	Grosvenor	6	12	3	0	A. Eyton	72	18	0
	Roman Gravels	30	12	5	0	Newton, Keates and Co.	367	10	0
	Isle of Man Mining Co.'y.	100	22	10	0	ditto	2250	0	0
,, 16.	Frongoch	90	12	0	0	Panther Company	2173	10	0
	,,	90	12	3	0	ditto			
	East Darren	77	15	0	0	ditto	1155	0	0
	Cwm Erfin	55	15	1	0	Sims, Willyams and Co.	827	15	0
,, 26.	Westminster	55	11	15	6	Newton, Keates & Co.	647	12	6
	Maesysafn	50	12	0	0	A. Eyton	600	0	0
	Mount Pleasant	50	12	6	6	Walker, Parker & Co.	684	7	6
	ditto	5	13	12	6	A. Eyton			
	Hendre Ucha	15	12	4	6	Walker, Parker & Co.	183	7	6
	Llangynog United	19	12	0	6	Newton, Keates & Co.	228	9	6
,, 27.	Clara United	20	11	15	0	Sims, Willyams & Co.	235	0	0

London Share-Market.

NOTWITHSTANDING the continued depression in trade generally, considering also the limited amount of business transacted in the metal trade, the Mining Market may be said to have gained, in the beginning of the month, a fair share of public attention, both in and out of the Stock Exchange.

The American difficulty still exercises a most unfavourable influence upon all our markets, and materially affects the operations of speculators and investors, which would otherwise naturally follow on the cheapness of money.

The absence of any very important discoveries necessarily adds to the prevailing dulness. The following are the chief mines which have been on the market:—South Caradon, Marke Valley, East Caradon, West Caradon, Devon Great Consols, Cook's Kitchen, Tincroft, Herodsfoot, South Frances, Wheal Seton, Providence, Margaret, Great Wheal Vor, West Seton, Clifford Amalgamated, Par Consols, East Basset, Wheal Mary Ann, North Downs, West Basset, Wheal Basset, Wheal Ludcott, Alfred Consols, West Par, Grambler and St. Aubyn, East Russell, Lady Bertha, Great Fortune, North Basset, Sortridge, Hingston Down, North Robert, West Polmear, North Treskerby, Wheal Arthur, Wheal Edward, East Grenville, Wheal Grenville, Wheal Moyle, Wheal Grylls, Wheal Uny, Wheal Unity, Great Retallack, East Carn Brea, Bryn Gwiog, Longrake, Tamar Consols, Rosewall Hill and Ransom, North Crofty, North Minera, West Rose Down, Wheal Union, Condurrow, Stray Park, Calvadnack, Wendron Consols, Billins, Drakewalls, Treloweth, Cargoll, Carn Camborne, Copper Hill, Wheal Norris, North Roskear, South Tolgus, and Wheal Agar.

South Caradon opened at 330 to 40, and a large number of shares changed hands at these prices. Subsequently, however, the quotations began to recede, owing to the fact that many of the holders were anxious to secure the advanced prices, and shares were rather forced upon the market. The mine is said to be in a very encouraging and prosperous condition. The latest closing quotations of these, as well as of other shares, will be given in a separate list at the end of this article, to which readers are referred. Marke Valleys continue to command a good enquiry, and are tolerably steady, and are more free from fluctuation than many other shares; the dealings have been generally between $9\frac{3}{4}$ and $10\frac{1}{4}$; the reserves of this mine are reported to be increased, and the coming dividend is expected to be *5s.* per share as usual; the next meeting is due about the 9th proximo. East Caradon shares have been largely dealt in, and advanced to $28\frac{1}{2}$ "buyers," but again declined a little, owing in some degree to the last sale of ore realising a less amount than was expected; the next meeting will be held at Salisbury early in January, when a dividend of 15*s.* per share will in all probability be declared. West Caradon have also been in considerable request, and improved to 51-53, but became less firm on the report that the new lode at the 80, and the 38 fathom level on Menadue lode had fallen off a little; the mine has, however, good prospects at present.

Devon Great Consols, 365-75 shares, frequently inquired for, but no sellers are to be found; the mine is reported to be improved, more particularly in the eastern ends. Cook's Kitchen have been steadily absorbed for investment, and price remains very firm at 29-30. Tincrofts have advanced to 7¾-8, with a good amount of business, but shares scarce. Herodsfoot, many transactions have taken place at prices varying from 38-39, and shares have been taken off the market as they offered; they are very firm in character, and the mine reported to be looking better than at any former period. South Frances, after declining to 85-90, with scarcely any buyers, have again become in request, and advanced to 110-15; the mine has considerably improved, and the report now current, that the suit pending between the West Basset adventurers and South Frances is about to be withdrawn from the House of Lords and settled amicably, has materially assisted to again enhance the value of these shares. Wheal Seton very freely dealt in, and has been subject to great fluctuations from day to day, with a scarcity of stock at the settlement. The agent's reports from the mine continue of a very favourable character; the range of the quotations recently has been between 120 and 130.

Providence shares have declined to 37-39, and remain dull, without much business. Wheal Margarets also receded to 38-40: a large business has been transacted, and they close firm. Great Vors were much sought after and advanced, but have again declined to 6½-7. West Seton, shade firmer in character,—385-95. Clifford Amalgamated, after remaining dull and neglected for a long time, have become in request, and advanced from 29 to 33 and firm. Par Consols occasionally dealt in at 7-7¼. East Basset drooping and very flat, at 50-55. Wheal Mary Ann shares recently advanced, owing to the improved appearances and prospects of the mine: they are now quiet at 16-17. North Downs declined to 4⅞ "sellers," but as the time drew nigh for holding the quarterly meeting the price began to rally; they recovered, and advanced to 5-5¼. At the meeting a dividend of *5s.* per share was declared, leaving over £700 to the credit of next account, and the prospects of the mine justify the expectation of a similar dividend at the next meeting. West Basset rather firmer, 14-15; the mine is improved. Wheal Basset 85-90, but not many transactions. Wheal Ludcotts have been in fair demand, and not many shares offering, 2¼-½. Alfred Consols, nominally 10*s.* to 20*s.* West Par improved in the 65, and also in the winze below the 55; shares quoted at 3s. 6*d.* to 5*s.* Grambler and St. Aubyn advanced from 13 to 20, but have again receded to 17-19; the prospects of this mine have improved during the last few weeks, and although time may be required for the further development of this property, there still remain some chances of success.

East Russell has again resumed calls, having at the last meeting made a call of 3*s.* per share; they close 3-½. Lady Bertha remain 13*s.*-15*s.*, without much inquiry. Great Fortune tolerably steady, at 11¼-12¾; not very many transactions. North Bassets very dull, and neglected at 2½-3; a call of 3*s.* per share was made at the last meeting. Sortridge Consols steady, 12*s.*-14*s.* Hingston Downs have receded to 3½-3¾, and only a limited inquiry. North Robert steady,

but very little doing, 19*s.*-21*s.* West Polmear gradually declined to 5*s.*; the next lode is expected to be met with in about two months. North Treskerby very flat, with many sellers, and have receded to 18-20. Wheal Arthur in request, owing to the improvement in Wheal Edward; they close easier, 13*s.*-15*s.* in sympathy with its neighbour. Wheal Edwards rose to 3¼ "buyers," but the advance was not maintained; they close 2½-¾. Wheal Grenville, which had been dull at 28*s.*-30*s.*, came into request on receipt of news announcing an improvement at the 80-fm. level west, and advanced to 35*s.* "buyers," but again receded a little. East Grenville also firmer on the improvement in Wheal Grenville. Wheal Grylls largely dealt in at various prices; they close flatter at 13½-14½.

Wheale Moyle steady at 2-2¼; the mine is gradually getting into a better position. Wheal Uny, many transactions at 4¾-5; a call of 2*s.* per share was made at the last meeting; this mine is looking exceedingly promising, and bids fair to become a prosperous concern. East Carn Brea transactions have taken place daily to a large extent, but the price seems to keep about 9½-10. There was no call required at the last meeting. It is now hoped that this mine will soon become remunerative to the shareholders.

Bryn Gwiog continue steady, at 26-28; they have a good course of ore in the shaft, where the sinking has been again resumed. Longrake have been dealt in between 13 and 15; the mine is reported to be much improved, both in the 48 east and in the winze.

Rosewall Hill and Ransom United, inquired for at 45*s.*-50*s.* North Crofty firm at 35*s.*-37*s.* 6*d.* North Minera; this mine is improved in the eastern shaft, 20*s.*-21*s.* West Rose Down very quiet, at 10-11; the next meeting will be due early in January, when a call will be required for current working costs. Wheal Union, 2-2¼; not much inquiry. Condurrow reported to be looking well, but shares are very dull at 62½-7½; the next meeting will be held some time in January.

Stray Parks occasionally in demand; price, 30-31. Calvadnack steady, at 7¼-¾; scarcely any inquiries. Wendron Consols, 10-½. Billins progressing favourably; price quoted 18-20. Treloweth declined to 20*s.* "sellers," but are now rather firmer, 1-1¼. Carn Camborne nominally quoted ⅞-1. Copper Hill very flat, 97½-102½. Wheal Norris frequently dealt in, 2⅛-⅜. North Roskear, 21-2. South Tolgus inquired for, but shares very scarce, 46-48.

In Foreign Mines there has been a good legitimate business done, in which St. John Del Rey, United Mexican, Scottish Australian, Port Phillip, Great Northern Copper, Bon Accord and East Del Rey, have been dealt in to a considerable amount. St. John Del Rey has shown a great deal of fluctuation between 51 and 48; they are, however, now a little steady, at 48½-9½. United Mexican have declined to 7½-¾. Port Phillips have remained tolerably steady, at 1¼-⅜. Scottish Australian have continued to advance, and are now quoted 1¼-⅜. Great Northern Copper, occasional transactions at 1⅜ and 1¼, but this market has not been very active. East Del Rey quiet and steady, at 1⅛-⅜. Dun Mountain continue to show firmness, 1-¼. Cobre Copper quiet, at 35½-6½. North Rhine have been dealt in at ⅝. In Kapunda, Linares, Lusitanian, Mariquita, Worthing,

General and Fortuna, there have been scarcely any dealings. Bon Accord very inactive at ¼-⅜.

Monday, December 30th, 2 p.m.

Since the above was written an important improvement has taken place in East Caradon, where a new lode was cut on the 21st in the 60-fathom cross-cut, south, worth from £20 to £30 per fathom as far as seen. This important discovery established an immediate advance of 1 to 1½ per share; but after touching 29⅜ "buyers," they became weaker on the report of a falling off in the value of the 50 east to £80 per fathom, the 60 east being worth £50 per fathom. With such a course of ore as this mine has, no shareholder should be disheartened at these temporary fluctuations.

West Caradon has gradually receded to 47-8. Towards the end of the month, the price of Seton has become more settled at 122-24. Providence shares have also again improved to 39 40. Clifford Amalgamated have slightly receded to 30-32; at the next meeting the accounts are expected to show a credit balance of £2,500. At West Basset the next sale of ore will be 480 tons. In North Roskear a course of copper worth £20 per fathom has been met with in the 184 west.

In Foreign Mines, United Mexicans have again advanced to 8½-¾.

The following are the latest prices of British and Foreign Mines :—

BRITISH.

East Carn Brea, Wheal Grenville, Great Fortune and Cook's Kitchen in good demand, with several buyers. East Caradon, West Caradon and South Caradon rather flatter. East Basset dull. South Frances firm. The American news is not considered unfavourable, and the prevailing impression is that there will be no war. Alfred Consols ½ to 1, Calvadnack 6 to 8, Camborne Vean 1¾ to 2, Copper Hill 95 to 105, Cook's Kitchen 29¼ to 29¾, Devon Great Consols 360 to 370, East Devon 1¾ to 2, East Basset 50 to 5[illegible]½, East Caradon 28¾ to 29, East Carn Brea 9¾ to 10, East Grenville 31/. to 33/., East Russell 3 to 3¼, Grambler and St. Aubyn 17 to 19, Great Wheal Fortune 12 to 13, Great Wheal Vor, 6½ to 7, Herodsfoot 38 to 39, Hingston Down 3½ to 3¾, Lady Bertha 11/. to 13/., Marke Valley 9¾ to 10, North Downs 4¾ to 5, North Robert 19/. to 21/., North Basset 2½ to 3, North Roskear 21 to 23, North Treskerby 18 to 20, North Minera 17/. to 19/., Providence Mines 40 to 41, South Phœnix 10/. to 15/., South Caradon 310 to 320, South Frances 115 to 125, South Tolgus 47 to 49, Stray Park 29 to 30, Tincroft 7¾ to 8, Treloweth 1⅛ to 1⅜, West Basset 14 to 15, West Caradon 44 to 46, West Rose Down 10 to 11, West Seton 275 to 285, Wheal Basset 80 to 90, Wheal Clifford Amalgamated 30 to 32, Wheal Cupid 29 to 31, Wheal Edward 2¼ to 2¾, Wheal Grenville 35/. to 37/6, Wheal Ludcott 2¼ to 2½, Wheal Margaret 40 to 41, Wheal Mary Ann 16 to 16½, Wheal Seton 121 to 123, Wheal Uny 4¾ to 5.

FOREIGN.

Dun Mountain pm. ⅜, Linares 7¼ to 7¾, Lusitanian 1½ to 2, General 23 to 24, Great Northern 1⅛ to 1¼, North Rhine 10/. to 11/., St. John del Rey 48 to 50, East ditto pm. ¼, United Mexican 8¼ to 8¾, Scottish Australian $1\frac{5}{16}$ to $1\frac{7}{16}$, Port Phillip 1⅛ to 1½, Bon Accord pm. $\frac{7}{16}$ to $\frac{9}{16}$, Kampunda 2 to 2⅛, Fortuna 1¾ to 2, Cobre 35 to 36.

Provincial Share Markets.

Dublin.—In the beginning of the month a steady demand was reported for dividend-paying shares, causing an improvement in Wicklow Copper shares of £2. 10*s*.; £53 to £55. 10*s*. being freely offered. Mining Company of Ireland shares suffered a reduction, but recovered, and were inquired for at £15. 5*s*. Speculative mines were not in favour. General Mining Company for Ireland shares neglected, although the chairman congratulated them "on the successful working of the machinery erected for the dressing of the Company's large deposit of calamine," and holds out hopes that the proprietors will soon have satisfactory results from the sale of metallic zinc and ochre. Connorree shares on sale at 31*s*. 6*d*., and business unimportant. Towards the middle of the month all affairs were disturbed by the American question, and mining shares of course participated in the general dulness. Wicklow Copper and Mining Company of Ireland shares were pretty steady, the former commanding £55 per share —buyers, and the latter being strongly in request at £15. 15*s*. General Mining Company for Ireland shares could be purchased at £5 each, but few were in the market. Connorree nothing doing. Later on in the month the death of the Prince Consort caused a general dulness, and mine securities suffered more neglect than any others, quotations being little better than nominal. Of the dividend mines the Wicklow Copper ranged from £53. 10*s*. to £54. 15*s*.—sellers. Mining Company of Ireland shares more steady, commanding £15. 7*s*. 6*d*. to £15. 10*s*. for cash or account. Of speculative mines the General Mining Company for Ireland were most in favour, though they dropped to £5. 5*s*., with signs of weakness. Connorree shares offered at 30*s*. to 31*s*. for long-deferred settlement. Towards the end of the month, although broken for business, transactions in mine shares were animated. Wicklow Copper and Mining Company of Ireland shares largely dealt in; the former, however, leaving off at 54, or a decline of about 10*s*. per share—sellers, while the latter experienced a rise of nearly ⅜, and are inquired for at 15⅞. General Mining Company for Ireland shares were in request at 5⅜, but are now readily obtained at a slight reduction. Connorree shares have fluctuated between 30*s*. 6*d*., 31*s*., 31*s*. 6*d*., and remain on sale at 32*s*. Carysfort shares have continued unsaleable during the month, no transaction being reported.

Miscellaneous.

A very valuable paper has been read at the Scottish Society of Arts, Edinburgh, by Mr. Ralph Moore, mining engineer, Glasgow, "On the Black Band Iron-stones of Edinburgh and the East Lothian Coal Field." The following description of this famous mineral may be interesting: "They (the Coal Measures) contain both clay-band and black-band iron stones. Clay iron stones contain from 30 to 50 per cent. of metallic iron. Before being smelted they are mixed with coal, and calcined in kilns, or large heaps, to drive off the carbonic acid gas, sulphur, and other impurities. This description of iron stone is found in seams or bands, and in nodules, throughout the whole of the measures; but is most plentiful in the lower part of the section. Black-band iron stone is a carbonate of iron, laminated with coal, generally in sufficient quantity for calcination without further admixture of coal, and leaves, when calcined, a metallic coke, containing from 50 to 70 per cent. of metallic iron. This description of ironstone is found in seams or bands, in well-defined positions in the measures;

but they are neither persistent in positions nor equable in quality. Sometimes the seam is wanting altogether, or so thin as to be unworkable; at other times the coaly element so predominates that its metallic value is of small amount; while not unfrequently it contains nothing but coal. A good black-band iron stone contains from 2 to 8 per cent of coal. When it contains more than 20 per cent. of coal it is of little value, unless mixed with clay bands, which use up the excess of coal. It is more easily smelted than clay band, requires less coal; and the weekly produce of a furnace on black band is 50 per cent. greater than from clay band."

Mr. Moore's sketch of the future of the make of iron in Scotland, from this mineral, is most interesting in a commercial point of view, and forms a valuable contribution to our knowledge.

At the meeting of the Geological Society of Manchester, on the 26th November last (Mr. Dickinson, inspector of mines, president, in the chair,) the first portion of a paper "On the Ventilation of Mines," was read by Mr. Joseph Goodwin. The paper was followed by rather a lively discussion, Mr. Chorlton and Mr. Fletcher deeming that it cast imputations on colliery managers. Mr. Goodwin considered that the furnace possessed an advantage over all other methods of producing ventilating currents, and that the objections raised against mechanical means of ventilation had proved too well grounded. Mr. Dickinson, without committing himself to any distinct opinion, and admitting the advantage of the old furnace for deep pits, took a more favourable view of the value of mechanical ventilation: he mentioned that he and his colleague, Mr. Atkinson, were engaged in a series of experiments on the ventilating appliances of this country, and also of Belgium, so as to ascertain the real value of the various motive powers. Mr. Chorlton referred to a ventilating fan at Earl Fitzwilliam's colliery at Elsecar, which, when perfected, would entirely supersede the furnace.

Mr. William Henderson, whose connection with the successful operations at Alderley Edge, Cheshire, had made him known to the public, proposes establishing extensive copper reducing works at Glasgow. Mr. Henderson, who is said to be connected with some well-known capitalists in London—among whom the name of a banker is mentioned—intends principally to deal with the burnt mundics remaining from the sulphuric acid works, of which Messrs. Tennant alone could probably supply from 500 to 1,000 tons per month. As this has now to be sent for sale to Swansea, where it is used chiefly as a flux, Mr. Henderson is very sanguine as to the great profits to be realized by treating it on the spot by the processes which he has patented. It is said that the site for the works is already acquired.

Under the heading "How would the war with America affect the coal trade," the *Colliery Guardian* has the following observations:—"A war with America would materially interfere with some branches of the coal trade, either by quickening the demand or by cutting it off altogether. Orders would be plentiful for good steam coal for shipping purposes, and thus a stimulus would be given to the trade both in South Wales and in the North-Eastern district; but on the other hand, the shipping trade of Liverpool in coal would be to a considerable extent extinguished, for much of the coal sent from that port goes to the United States. A great quantity of cannel is shipped from Liverpool to New York and other American ports, and of course these shipments would be completely stopped in the event of

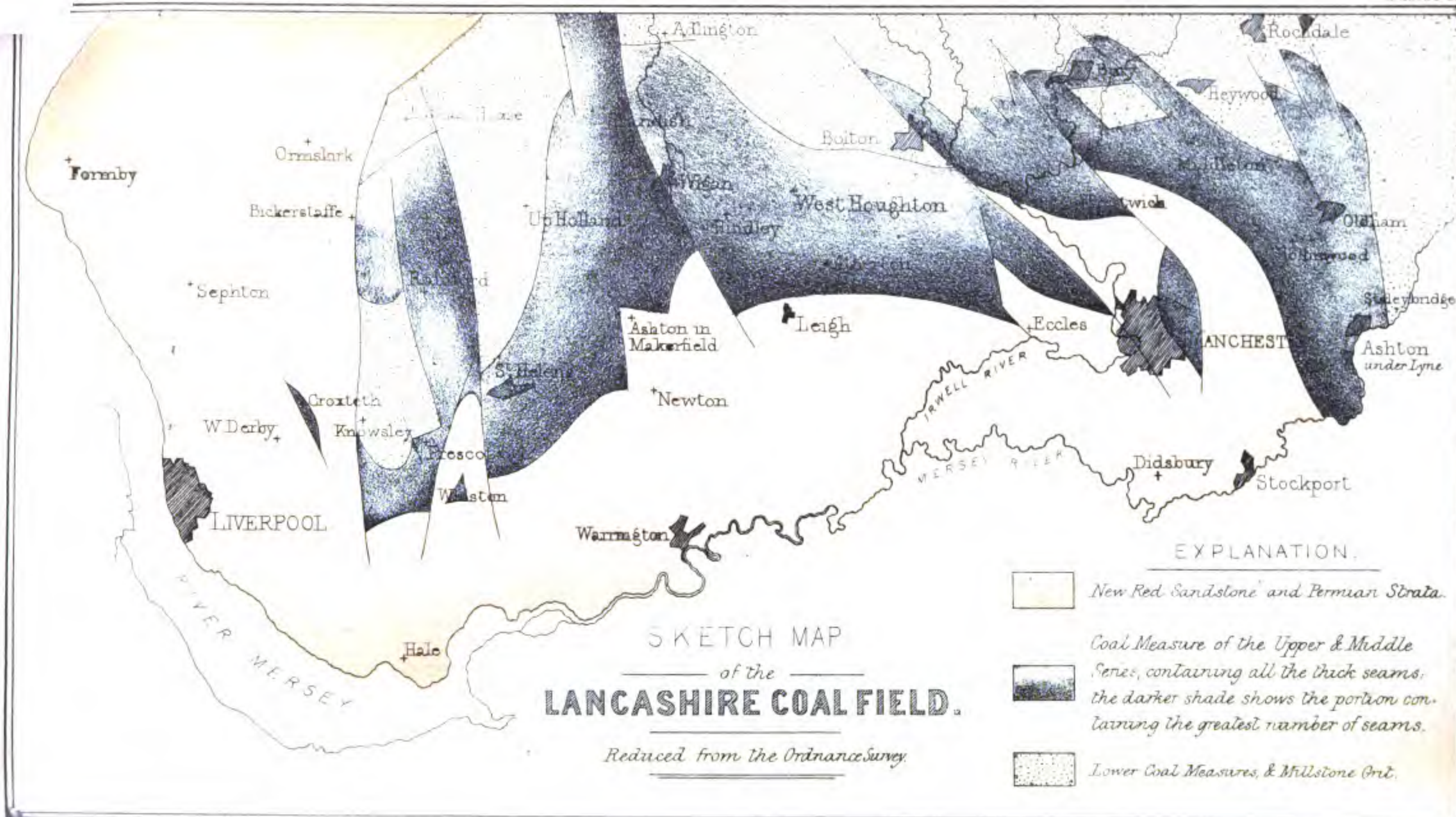
a war. On the whole, however, the coal trade would suffer less from an American war than any of the other great branches of national industry, for the principal part of what we raise is for home consumption, while of our shipments the whole of North America does not take more than one-twentieth part. The loss of the American trading in coal and cannel will be severely felt by some of the large colliery owners of South Lancashire, and thus the calamity will fall upon that district which already suffers most severely from the war in America; but taking the trade generally, the decreased demand from our friends across the Atlantic will be more than compensated by the additional demand from our own Government."

Mr. Alexander Macrae, oil and produce broker, of Liverpool, in a circular dated 16th December, says:—

"The introduction of petroleum, kerosine, photogene, or rock and well oil, is making tremendous strides, though it does not surpass the prediction in my first circular, namely, that it would be second only in extent to cotton. I will even go a step further, and venture to assert that if the rocks and wells of Pennsylvania, Canada, and other districts, continue their exudation at the present rate of supply, the value of the trade in this oil may even equal American cotton. Montreal (internally, and likely externally by this time) is lit with the white refined, and I can see no reason why London and Liverpool should not also be, for the oil gas distilled trom the raw petroleum is immensely superior and much more brilliant than our own coal gas. For years we have sent coals to America for gas-works, and it will be a singular freak of events if she and Canada should now supply us with a better expedient. Invested interests will perhaps stay it for the moment, but will they ultimately?

"The refined for burning (known in this country as paraffin oil, and of which about 500 tuns a week are sold), has been selling at £30 to £40 per tun (of 252 gallons) for yellow to white, while the crude varies in value from £6 to £25, according to test. The merits of the petroleum will be better understood when importers are informed that besides the uses already named, lubricating oils of every colour and specific gravity can be obtained from it; wax also for the manufacture of paraffin candles, naphtha, and consequently benzole (from which the fashionable dyes, magenta, rosenine, anneline, &c., are obtained), pitch, &c. &c., all of them having several other applications. It is reported on the very best authority that they have discovered from it now an available substitute for spirits of turpentine for paints, and also a solvent for india-rubber; results, I understand, that they have not effected in America or Canada, and the importance of which cannot be overestimated.

"In my first circular it was stated that some 7,000 barrels of crude and refined were on the way to this country, and the *Times* of the 13th instant mentions 8,000 barrels on the way to London. There are 10,000 barrels coming to Liverpool, and 2,000 barrels to Glasgow, in all about 20,000 barrels, (or £100,000 sterling, and the trade not six months old), a simple tithe of what we want! American hostilities and the ice in the St. Lawrence (although we have still St. John's, New Brunswick) may stop supplies to some extent, but I have no doubt the future will vindicate the expectations I have so frequently expressed.


Formby
Ormskirk
Bickerstaffe
Sephton
W Derby
Croxteth
Knowsley
Prescot
Widnes
LIVERPOOL
Up Holland
Adlington
Wigan
Hindley
West Houghton
Bolton
Ashton in Makerfield
Leigh
St Helens
Newton
Warrington
Hale
RIVER MERSEY
Eccles
IRWELL RIVER
MERSEY RIVER
Didsbury
Stockport
Heywood
Rochdale
Oldham
Ashton under Lyne
SKETCH MAP
of the
LANCASHIRE COAL FIELD.
Reduced from the Ordnance Survey
EXPLANATION.
New Red Sandstone and Permian Strata.
Coal Measure of the Upper & Middle Series, containing all the thick seams; the darker shade shows the portion containing the greatest number of seams.
Lower Coal Measures, & Millstone Grit.

THE

MINING AND SMELTING MAGAZINE.

FEBRUARY, 1862.

Notes on the Gold Deposits of Nova Scotia.

By J. Arthur Phillips.

The whole of the Atlantic shore of the province of Nova Scotia is bordered, in an unbroken line, by strata of a metamorphic character and probably great geological antiquity, frequently broken through by eruptive rocks. These form a coast in some places low and rugged, and in others boldly undulating; their soil being generally rocky and sterile, although there are large tracts well covered with timber, and affording prosperous agricultural settlements. Along the Atlantic shore this district is generally low, gradually rising to the height of some three hundred feet at its northern extremity. Its southern or coast line has, according to Dawson, a general direction of south 68 deg. west, whilst its inland side, although presenting some considerable undulations, has a general direction of south 80 deg. west. The extréme breadth of this band at Cape Canseau, its north-eastern extremity, is about eight miles, whilst in its extension westward it gradually increases, until at the head of the west branch of the St. Mary's River, eighty miles west of Cape Canseau, it is about thirty miles wide. In the western counties its breadth is known to increase still further, and although its northern boundary has not as yet been accurately ascertained, its total width cannot be far short of fifty miles. Its length corresponds with that of the peninsula of Nova Scotia.

This band, in which the whole of the gold hitherto discovered has been found, chiefly consists of thick bands of slate and quartzite, highly inclined and having a general north-east and south-west strike. In different localities these rocks, which probably belong to the lower silurian epoch, have been penetrated by masses of granite, and in their vicinity the quartzites and clay-slates are usually altered into gneiss and mica-slate, or other rocks presenting a more than ordinarily metamorphosed appearance. Since the gold discoveries in California and Australia have become generally known, and public attention has been directed to the circumstances under which au-

riferous deposits usually occur, reports of similar discoveries have from time to time locally arisen in different parts of Nova Scotia. In every instance, however, either iron pyrites or bright golden scales of mica, occurring with more or less highly coloured sands in the beds of various mountain rivulets, would appear to have been mistaken for the precious metal. Some years since, also, an article on the subject of gold mining appeared in *Blackwood's Magazine*, in which it was affirmed that gold would be found in the hills to the south of Annapolis, and comparisons were instituted between this locality and the valley of the Sacramento.

At the time of its appearance, this article produced much excitement in the colony, and rumours of actual discoveries of gold found their way into the local papers. Many persons were thus induced to leave their ordinary employments in order to seek for gold; but their search having in all cases proved unsuccessful, the excitement gradually subsided, and the subject was ultimately forgotten.

It is also worthy of remark, that Dr. Dawson, when describing, so long ago as 1855, the great metamorphic band on the Atlantic shore of Nova Scotia, observes—"Quartz veins, however, occur abundantly in some parts of this district, and it would not be wonderful if some of them should be found to be auriferous."

There is, nevertheless, no authentic evidence of the discovery of the precious metal in this province previous to 1860, when some hundreds of persons, tempted by rumours of the existence of gold, commenced exploring in the woods near the head waters of the Tangier, about ten miles from the sea coast, and proved the presence of this metal in small quantities. The amount of gold obtained was, however, so small, and the distance from roads and navigation so considerable, that the miners became discouraged and the excitement quickly subsided.

In the month of March last year, a man who was stooping to drink at a brook observed a small piece of gold among the pebbles at the bottom, and having picked it up searched and found other specimens. This took place about a mile to the eastward of the mouth of Tangier river, a locality most favourable for the prosecution of mining operations, and within half a mile of a safe harbour.

From this date attention became directed to the locality, and numerous claims were taken up and worked by the people of the neighbourhood, who obtained considerable amounts of gold by breaking the quartz rock with hammers and washing the resulting sand in tin pans. The success attending these rude operations being considerable, population immediately rushed in; a large area of claims was taken up, and sundry arrastras and Chilian mills were erected.

In June the discovery of gold was reported in the county of Lunenberg, at a locality called the "Ovens," on a peninsula which forms the western boundary of Lunenberg harbour, and at a distance of about five miles from the town of that name.

The veins of auriferous quartz in this place, although small, are frequently very productive, and appear to cross each other in almost all directions, in a metamorphic shale belonging to the great southern band. On these discoveries being made public numerous claims were ιediately taken up, and various local companies formed, with a

view of working the veins presenting themselves numerously in the cliff.

While attention was thus generally directed to quartz mining, Mr. Campbell, an amateur geologist of the province, tried the experiment of washing the sands accumulated on the sea shore, and having been successful beyond his expectations, there was a general rush from the upland mining to claims situated at the foot of the cliff; numerous claims were quickly staked off, and worked by means of cradles and tin pans, so that the aggregate daily yield of the several shore operations shortly reached one hundred ounces.

Shortly after public attention had thus been attracted to Lunenberg, auriferous quartz was also found at Dartmouth, Lawrencetown, and Sheet Harbour, and these discoveries were rapidly followed by others at Wine Harbour, Isaac's Harbour, and Sherbrooke, as well as at Laidlaw's Farm, on the western side of Lake Thomas, where magnificent specimens were obtained from a tortuous bed of quartz, lying at a depth of about four feet from the surface, and also from various loose boulders found on the surface of the soil.

More recently gold has been discovered at Little Chester, on the South or Horton Mountain, and reports almost daily reach Halifax of gold having been found in greater or less quantities at various localities situated in different parts of the great southern band of metamorphic shales before described.

In addition to the metamorphic rocks on the Atlantic shore of Nova Scotia, there is another belt in the northern part of the province, much resembling the great coast band, but probably belonging to a more recent formation. This district is mainly composed of talcose and chloritic shales, occasionally penetrated by green-stone, syenite, and granite; and as numerous quartz veins, containing iron pyrites, have been discovered in these rocks, it is more than probable that gold may ultimately be found in them.

It would be impossible to form any reliable estimate of the total amount of gold obtained in Nova Scotia since its first discovery in the province, as the claims are for the most part worked by private individuals, who are, generally speaking, indisposed to furnish information relative either to their success or failure.

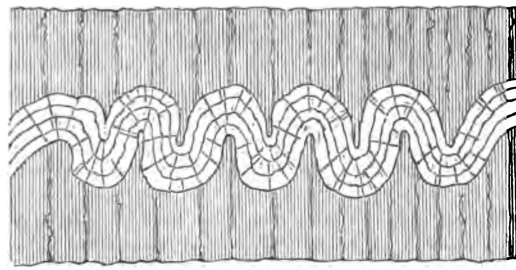
The most remarkable deposit of auriferous quartz hitherto discovered in Nova Scotia is undoubtedly that found at Laidlaw's Farm.

The claims in which the largest amount of gold-bearing quartz has been discovered are near the summit of a hill composed of hard metamorphic shales, and openings have in several places been made to the depth of some four or five feet, upon a corrugated band of quartz of from eight to ten inches in thickness. This deposit of auriferous quartz is entirely different from anything I have before seen, and when opened upon presents the appearance of trees or logs of wood, laid side by side, after the manner of an American corduroy road.

From this circumstance the miners have applied the name of barrel quartz to this formation, as in some cases it presents an appearance not unlike a series of small casks, laid together side by side and end to end.

The following sketch may, perhaps, explain better than words the mode of occurrence of this deposit:—

The rock covering this peculiar horizontal vein is exceedingly hard, but beneath it, for some little distance, the shale is softer, and somewhat more fissile than above. The quartz is itself foliated parallel to the lines of curvature, and when broken exhibits a tendency to break in accordance with these striæ. These headings, and particularly



the upper surfaces of the corrugations, are generally covered by a thin bark-like coating of brown oxide of iron, which is frequently seen to enclose particles of coarse gold, and the quartz in the immediate neighbourhood of these ferruginous bands is itself sometimes highly auriferous.

It is also worthy of remark, that the headings occurring between the foliations of the quartz do not so frequently as the exterior coating of the upper surface of the deposit contain visible gold.

The permanent value of such a deposit will evidently depend not only on the richness of the quartz found, but will also be much affected by the amount of auriferous rock to be obtained ; and it is, therefore, of much importance to ascertain the superficial extent of the bed, and if others may not exist beneath it. It would likewise be desirable to determine whether, at some point in its course, it may not assume an inclined position and present the appearances of an ordinary quartz vein.

The other gold veins of the province present, generally speaking, few distinctive peculiarities, and very closely resemble those found in California and Australia. Their general course is about north 60° west, and their dip towards the south ; but there are not unfrequently exceptions to this rule. In addition to gold, the auriferous veins of Nova Scotia contain considerable quantities of iron pyrites, mispickel, galena, blende, and less frequently small quantities of argentiferous sulphide of copper. Here, as elsewhere, the presence of metallic sulphides is considered a good indication of a vein being auriferous, and veins containing disseminated galena are almost invariably found to contain a remunerative quantity of gold.

The productive gold veins hitherto discovered have, as before stated, all been found in the older rocks on the Atlantic shore, and commonly occur in parallel groups, through the centre of which, and parallel to the productive veins, on either side of it, a large reef of crystallized and comparatively non-auriferous quartz is in many instances found to run.

These large courses of quartz, or "bull veins," as they are locally called, usually contain traces of the precious metal, but not in sufficient quantity to pay the expenses of working by the appliances now in use, and the attention of the miner is therefore exclusively directed to the smaller but richer lateral veins which often afford quartz yielding from five to fourteen ounces of gold per ton.

The only crushing and amalgamating appliances in the colony consist of a few arrastras and Chilian mills, each capable of crushing about a ton of auriferous quartz per diem.

The attention of the local miners has been almost entirely directed to the exploration of the numerous quartz veins, and placer diggings have been consequently all but entirely neglected; it is, however, probable that a careful examination of the alluvial deposits in the vicinity of some of the principal rivers would result in the discovery of rich deposits of placer gold.

An analysis of the Tangier gold, specific gravity 18·95, gave,*

Gold	98·13
Silver	1·76
Copper	0·05
Iron	trace.
	99·94

An analysis of Lunenberg gold, specific gravity 18·37, gave,

Gold	92·04
Silver	7·76
Copper	0·11
Iron	trace.
	99·91

The Tangier specimen was taken from a quartz vein, and is remarkable for its purity. The Lunenberg gold was in small particles washed from the sands on the sea shore.

A geological survey of the province of Novia Scotia is much required, and would probably lead to the discovery of other useful minerals in addition to those already worked. The districts in which gold has been discovered, and in which it will probably be found, have been as yet only casually examined; but the great extent of metamorphic strata in the province, and the success that has attended the explorations hiterto made, indicate that a new and important source of mineral wealth will ere long be added to this already flourishing colony.

The Lancashire and Cheshire Coal-fields.

By Edward Hull, B.A., F.G.S.,
Of the Geological Survey of Great Britain.

If we observe the distribution of our centres of manufacturing industry, whether it be those of the harder or softer fabrics, we cannot but be struck by the fact, that it depends essentially on the mineral resources, rather than on physical or topographical advantages. The iron-works of South Wales and Staffordshire, of Low Moor and

* Analysis by O. C. Marsh, of Yale College.

Cleveland in Yorkshire, and of Lanarkshire in Scotland, are examples of the one kind; the cotton mills of Lancashire, and the cloth and silk factories of Derbyshire and Yorkshire, are examples of the other. That mineral resources will ultimately prevail in localizing a special branch of industry, and are a more powerful influence for this purpose than any that may be derived from relative position, climate, elevation or any similar circumstance, is also illustrated by the migration of the West-of-England woollen manufacturers to the north, and by the establishment of smelting furnaces at Swansea, at a considerable distance from Cornish mines whence the ores are principally derived. The county of Lancaster exemplifies this principle in numerous instances. We find the cotton factories concentrated over, and around the coal-bearing area, while at Liverpool—the port at which the raw cotton is landed, but which is situated about ten or twelve miles beyond the boundaries of the coal-field—not one factory has been erected.

From all this we see that the position and extent of our *foci* of industry are essentially dependent upon the supply of mineral fuel, and that the force generated by its combustion is the very life of that complicated and varied mechanism which ministers to our wants and our prosperity as a nation.

Regarding the city of Manchester as the heart of the cotton trade, a few observations to illustrate its peculiar fitness in a physical point of view for assuming this position may not be without interest. The city (including Salford) stands on the New Red Sandstone, a most excellent foundation, whether, from its firmness and porousness, as a site for building, or as a source of water-supply. In this respect Manchester resembles Liverpool, Chester, Birmingham, Notts, and many other large towns.* In the next place, the city stands at or near the confluence of several rivers of considerable size—the largest being the Irwell, which is about the breadth of the Thames at Oxford. The other streams are the Irk and the Medlock. It is scarcely necessary to say that water is essential to the working of the mills and bleach-works, but long before reaching Manchester these streams have degenerated into noxious sewers, so that the mills depend either on wells, or supply from the water-works. The third point is the proximity to the port of Liverpool through which the factories are fed with cotton. Until the introduction of railways, this material was conveyed by barges along the Bridgewater canal and the river Irwell, but is now brought by all these modes of conveyance. The fourth and last advantage, and that without which all the others would have proved unavailing, is proximity to the Great Lancashire coal-field, which stretches to the west, the north, and the east of the city, into which the mineral is being constantly poured by roads, railways and canals, all converging towards this centre of consumption, from the districts of Wigan, Worsley, Pendleton, Clifton, Middleton, Oldham, and Dukinfield.

* In the case of Manchester, a great portion of the buildings are deprived of the benefits arising from the foundation of new red sandstone, as over this formation there is generally a considerable thickness of boulder clay. As a source of water supply, however, it is highly appreciated—many of the factories and bleach-works being supplied from wells sunk through the "red rocks."

The Lancashire coal-field* stretches in a crescent shape from Huyton near Liverpool to Ashton-under-Lyne, where, upon crossing the river Tame, it enters Cheshire and stretches southward towards Macclesfield. In its range it embraces the important towns of Prescot, St Helen's, Wigan, Bolton, Radcliffe, Bury, Heywood, Rochdale, Middleton, Oldham, Ashton-under-Lyne, and Staleybridge. Its extreme length from west to east is about 32¼ miles, and its average breadth 6 miles. Its area is 192 square miles, or including the Manchester coal-field, which is isolated from the main area, 197 square miles; and it contains, according to my calculation, about 3,700 millions of tons of coal to a depth of 4,000 feet from the surface.†

The coal measures are divisible into three well-defined stages, as follows :—

The Upper.—Represented most completely at the east side of Manchester, containing several beds of limestone ; 8 seams of coal, of which 4 are workable; a bed of calcareous hæmatite, which is now being worked at Patricroft. Thickness of the series 700 yards.

The Middle.—Containing all the thick coal seams. Of these there are 18 workable in the Huyton and Halsnead district, 17 in the St. Helen's district, 17 in the Wigan district, 16 in the Worsley and Clifton district, 12 in the Radcliffe district, 20 in the Oldham, Ashton and Dukinfield district, and less than half the number in the district of Poynton, where the series is incomplete. Thickness 1,000 yards.

The Lower.—Containing several thin coals, of which the most important is the Gannister seam, from 2 to 2½ feet in thickness. This seam is worked amongst the hills east and north of Staleybridge, Oldham, Rochdale, Bury and Bolton. But at Chorley a higher, and at Up-Holland and Billinge a lower seam is the principal coal belonging to this series. Thickness 600 to 700 yards.

At the base of all the above measures lies the "Rough-rock" or Uppermost Millstone, under which there are two or three lower seams of coal, seldom sufficiently thick for working.

We shall now give a few particulars regarding the principal coal-seams of each district; premising, however, that there are in these districts other seams of value, which space will not allow of description. Commencing with ST. HELEN'S :—

* This coal-field has been partially described by several authors. The earliest notice partaking of a geological description is that of Mr. Elias Hall, who produced a map showing the range of the different coal-seams; it is, however, extremely inaccurate, though great allowance must be made on account of the state of our knowledge at the period in which it was published. In 1837, Mr. James Heywood, F.R.S., &c., published in the pages of the Trans. of the Liter. and Philos. Society of Manchester a short but valuable description, accompanied by a coloured geological map, in which the boundaries of the coal-field, and some of the outcrops of the coal-seams and faults, are laid down with accuracy along the southern margin. From 1839 up to the present time, Mr. E. W. Binney, F.R S., has contributed a series of valuable papers, published in the pages of the Transactions of the Geological and Philosophical Societies, which have rendered the structure of this district as well known as that of any other coal-field in England. The most recent publications are the maps of the Geological Survey, now in progress, and several memoirs by the author on the districts of Prescot and Wigan, 1860. We should add, that Mr. John Hall and Mr. F. Looney have done much in the elucidation of the structure of this part of Lancashire.

† "The Coal-fields of Great Britain." 2nd Edit., p. 130.

The three best seams are the *St. Helen's Main Delf*,* the *Ravenhead Higher and Main Delf*, and the *Rushy Park Delf*. The St. Helen's Main Delf has been reached at a depth of 500 yards; its average thickness is 9 feet; it rests on a floor of black bass, and has a roof of sandstone 23 yards in thickness. A few feet underneath is a seam of cannel, about 2 feet thick, which has only been worked to a very limited extent, though stated to be of good quality.

The *Ravenhead Main* Coal lies 122 yards below the St. Helen's Main Coal; its thickness is 7 feet, with a roof and floor of clay, locally called "Warrant." † This forms a very bad support, and necessitates a portion of the seam being left.

Rushy Park, or *Orrell 5-feet Coal.* At a depth of 254 yards below the last is the *Rushy Park Mine*—a most valuable seam over the western and southern part of the coal field, but one which becomes deteriorated both in thickness and quality from Wigan, eastwards; its thickness in the neighbourhood of St. Helen's and Prescot is from 4 to 5 feet, with a roof either of shale or sandstone. West of Wigan it becomes the celebrated Orrell 5-feet seam, long esteemed in the market, but now exhausted over a large extent of country. At Wigan it becomes the *Smith Coal*, and in the direction of Bolton and Clifton the *Three-quarters Mine*, its thickness having diminished to 27 inches.

A remarkable change supervenes in the case of the *St. Helen's Main Delf*, and two underlying seams when traced eastwards to the Haydock Collieries, near Ashton, in Makerfield, where they become the *Florida Mines*, and northward to Wigan, where they become the *Pemberton Mines*. These changes will be best understood by reference to the following table :—‡

REPRESENTATIVE SERIES OF COALS, &c.

St. Helen's.	Ft.	In.	Haydock.	Ft.	In.	Wigan.	Ft.	In.
St. Helen's Main Coal	9	0	*Higher Florida Coal*...	4	6	*Pemberton 5-feet Coal*...	5	0
Strata	9	0	Strata, with a band of black bass representing the Cannel of St. Helen's ...	24	0	Strata	30	0
Cannel...	2	3				*Coal* (good quality)	2	6
Strata	18	2				Strata	45	0
Four Feet Coal ...	4	0	*Lower Florida Coal*, with a parting of clay 2 ft. 9 in.... ...	10	9	*Pemberton 4-feet*..	4	6
Strata	46	2	Strata	36	10	Strata without any workable coal seam	445	0
Roger Coal	2	0	*Stoney Roger Coal*	3	4			
Strata	7	4	Strata	126	0			
Pigeon-house Coal.	2	0	*Pigeon-house Coal*	3	0			

* The term "Delf" is generally applied to a coal-seam in the west part of Lancashire. At Wigan, Bolton, and eastward, the term "Mine" is used in the same sense.

† "Warrant," or "Warren Earth" is the term usually employed to designate the clay-floor or under-clay of a coal-seam.

‡ "Geology of the Country around Wigan," p. 17.

WIGAN DISTRICT.—The principal seams in this district are in descending order; the *Ince Yard* 4 *feet and* 7 *feet*, the *Pemberton* 5 *feet and* 4 *feet*, the *Cannel*, the *Haigh Yard*, and the *Arley Mine* or *Orrell* 4-*feet Coal*.

The *Ince Mines* are of fair quality, though rather soft, and their value seems to vary inversely as their thickness. As these seams are generally very shallow, they have already been exhausted over the greater extent of their area.

Of the two *Pemberton Mines* the 4-*feet seam* is superior to the 5-*feet seam*, and is justly held in high estimation. It has generally a good roof, and has been largely worked at Standish, Pemberton and Ince.

The Cannel.—This celebrated mineral is mentioned by Camden* as having been obtained early in the 17th century from Haigh, near Wigan. Along the rising grounds of Haigh Hall, to the north-east of the town, this seam crops out, and has been extensively wrought from "day-eyes" or adits driven into the side of the hill. It is remarkable that the Cannel Mine attains at Wigan its greatest thickness of 3 feet, from which, as a centre, it thins away in every direction, or else passes into common coal. As seen in the galleries of the Rose Bridge or Ince Hall Collieries, or in solid blocks, this mineral has all the appearance of black marble, and is capable of receiving a high polish. It is almost exclusively employed for gas, and it fetches at the pit mouth nearly double the price of ordinary coal. It is almost unnecessary to state that the extraction of a seam of such value has been very rapid, and that it is already exhausted over a very large tract of country; in fact, we shall probably not be in error in stating that this is the case within a vertical depth of 300 yards. The district of Wigan is, however, peculiarly constructed. It is traversed by a series of parallel faults, varying N.N.W. and S.S.E., described by the late Mr. Peace,† and is thus parcelled into several "belts," of which one series are *up-casts*, the others *down-casts*. Several of the largest collieries—as those of Ince Hall, Kirkless Hall, and Haigh—are situated on the up-cast or "shallow belts," and over these the Cannel, as well as other adjoining seams, have already been very largely extracted. In the deep belts, however, there still remains an almost unbroached reservoir of several of the most valuable seams, including the *Cannel*, the *King*, the *Yard*, and the *Arley* Mines. In one of these belts, which ranges by the west side of Wigan, the Cannel has lately been reached at a depth of 600 yards by the Ince Hall Company; and in another deep belt at Rose Bridge Colliery, near Ince, the same mine has been wrought since June, 1858, at an equal depth of 600 yards, through a shaft with a "double lift," being at that time the greatest depth attained in Britain. (See fig. 1.) The roof of this seam is composed of strong black shale, very tenacious, and celebrated for the specimens of fish-remains it has yielded.

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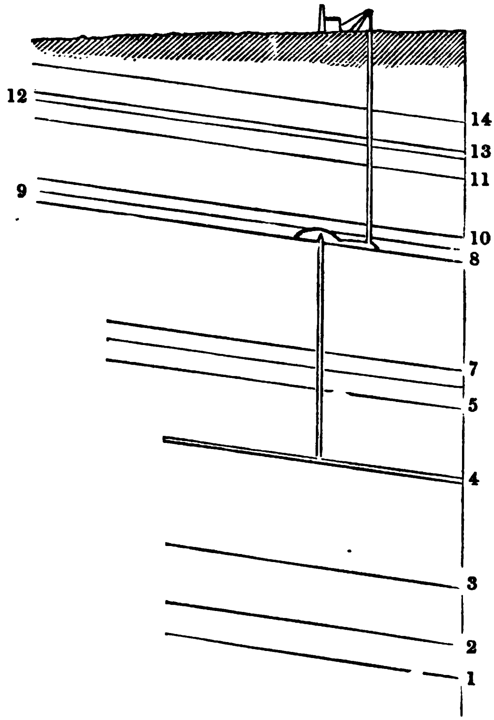
* Britannica, Vol. iii., p. 300.

† British Association Reports.

Fig. 1.

SECTION AT ROSE BRIDGE COLLIERY, TO SHOW THE SUCCESSION OF COAL MEASURES AT WIGAN.



The Colliery at Rose Bridge is worked by a double lift. The first shaft was sunk 298 yards to the Pemberton Four-feet Mine (8) in 1854. This coal was worked for some time, when it was determined to sink a new shaft (No. 2) from the Four-feet Seam down to the Cannel and King Coals (4). This was commenced in September, 1857, and reached the King Coal in June, 1858, at a depth of 300 yards; the total depth of the two shafts from the surface being about 600 yards. The second shaft is worked by independent engines and lifting gear erected in an excavation or chamber in the strata above the Pemberton Four-Feet Coal. This plan of a double lift has the advantage of greater security, but entails a loss of time and increase in expense of getting the coal.

The coal-seams shewn in this diagram are: 1. Arley Mine. 2. Orrell 5 feet or Smith Coal. 3. Yard Mine. 4. Cannel and King Coals. 5. Wigan 9 feet. 6. Wigan 4 feet. 7. Wigan 5 feet. 8. Pemberton 4 feet. 9. 2 feet. 10. Pemberton 5 feet. 11. Furnace Mine. 12. Ince 7 feet. 13. 4 feet. 14. Yard Mine.

The *Haigh Yard* coal is of excellent quality, and produces a good coke; its thickness is sometimes as much as 4 feet.

The *Arley Mine.*—This seam is only second in value to the *Cannel*, at Wigan. It yields a large quantity of gas, and its slack works into a fine coke. Its thickness varies from 4 to 5 feet, and it is raised from several very deep collieries at Ince, Gidlow Lane, Kirkless Hall, and Haigh.

Pendleton and Clifton Districts.—The coal seams of Wigan y all be traced eastwards to the Irwell, across the districts of

Hindley, Tyldesley, Hulton, Worsley, Clifton, and Pendleton; but they all undergo changes in quality and development upon reaching this position. Thus the *Arley*, *Haigh Yard*, and *Cannel* seams have degenerated and become of little value, while the three *Wigan* Mines are found to have as constantly improved, and in this state are known under the names *Trencher Bone*, representing the *Wigan 9 feet*; the *Five-quarters* and *Old Doe*, representing the *Wigan 4 feet*, and *5 feet* Mines. Above these are the *White* and *Black* Mines, two valuable seams, especially the latter, and which, at Atherton and Tyldesley, unite to form a solid seam from 7 to 8 feet in thickness, of excellent quality; while at Clifton they are separated by 84 feet of strata. Above these, at a distance of 95 yards, is the *Rams Mine*, a thick and valuable seam, representing the Ince "7 feet" coal of Wigan. It is extensively wrought at Atherton, Tyldesley, Worsley, and Pendleton.* The highest workable coal is the *Worsley 4 feet*, a seam which has been very largely extracted along the southern margin of the coal-field, and is now being wrought at Bedford Colliery† by a shaft which passes down to this coal through the New Red Sandstone and Permian strata. This seam has been identified by Mr. John Hall and Mr. E. Binney with the "four-feet" coal of Clayton and Bradford Collieries in the Manchester coal-field;‡ but through some unexplained cause the underlying thick seams have never yet been reached beneath the Clayton coal, although sunk and bored for to a depth far below their position on the west side of the Irwell.

To the N.E. of the Great Irwell Valley fault we find several very thick seams, formed by the union of those which S.W. of this fault are more or less separate. Thus above the *Trencher Bone*, *The Doe*, and *Five quarters* Mines, we have the *Lower Three Yards Mine*, formed by the junction of the *White* and *Black* Mines; then a *Two Yards* Mine, representing the *Rams*, and the *Upper Three Yards*, formed probably of the *Crumbourke* and *Shuttles* seams. These seams have been, and are, largely worked east of Bolton, at Little Lever and Radcliffe Bridge. Over this tract the dip of the beds is steep, being from 25° to 35° towards the south and south-west.

Between Radcliffe Bridge and Middleton, and southwards to Whitefield, there is a considerable tract of country almost profitless for coal, or which contains only the *Royley* or *Arley Mine*. This latter seam, in the direction of Rochdale, is repeatedly thrown out by large faults.

Oldham and Ashton Districts.—Hitherto the general trend of the strata has been from west to east; but near Rochdale, Middleton, and Oldham, the beds are bent round, and henceforth trend to the south, rising towards the east at steep angles (25° to 40°), and cropping out by Oldham, Staleybridge, and Poynton.

The coal-series of Oldham, Ashton, and Dukinfield, contains about 38 seams, which have all been worked. As a general rule, however,

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* At Pendleton Colliery, sunk through the edge of the Great Irwell Valley fault, this seam is worked by Messrs. Andrew Knowles and Son at a depth of 536 yards.

† By Messrs. S. Jackson and Co.

‡ On the *Lancashire and Cheshire Coal-field*. Trans. Geol. Soc., Manchester, vol. i., p. 73.

the seams at the eastern side of the Lancashire and Cheshire coal-field are thin, and much split up by partings of shale.

The *Royley* or *Arley Mine*, at the base of the middle coal-series, has been extensively worked around Oldham, and as far south as Lees, but has never been proved at Ashton-under-Lyne. Further south, it is considered, with great probability, to be represented by the Upper Woodley Mine, which has been worked in Cheshire, and upon this supposition we have been enabled to trace this remarkable coal-seam over the entire coal-field, with an area of nearly 200 square miles. It is considered, also, to reach into Yorkshire and Derbyshire, where it is called the *Black Shale* or *Clod-coal*.

The *Black Mine* forms the most valuable seam of this district: Oldham and Ashton are built upon it, and, consequently, the interior of the earth is perfectly honeycombed under these densely-populated towns. Under Oldham, indeed, little of this seam remains entire, and the workings have advanced towards the west and south, where a large area still remains, most of which is in the hands of the Chamber Colliery Company. It is this seam to which the Astley Pit of Dukinfield Colliery has been sunk, at a depth of 687 yards, the greatest yet attained by one vertical descent in Britain, if not in the world. The workings in this magnificent colliery extend, however, to a considerably greater depth even than this. The dip of the Black Mine being rapid, and the seam having been followed by a "down-brow" tunnel, a depth of, we believe, 2,500 feet from the surface has already been reached; and should it be found practicable to drive in the same direction to the extremity of the estate, a total depth of about 3,300 feet or more will ultimately be attained. We look forward with extreme interest to the progress of the workings of this remarkable colliery. Much light may be thrown on the effects of the weight of the superincumbent strata, the pressure of the atmosphere, the powers of ventilation, and of the increase of temperature at great depths. Already two of these influences, namely, the thrust of the strata, and increase of temperature, are making themselves very sensibly felt; but we feel sure that, under the skilful management of Mr. Charlton and his intelligent underlooker, these obstacles to the extraction of the coal will (as far as is possible) be surmounted.

The Black Mine varies in thickness from 4 to 5 feet, and at a short distance below it is a seam which yields a good cannel, about 18 inches thick at Dukinfield.

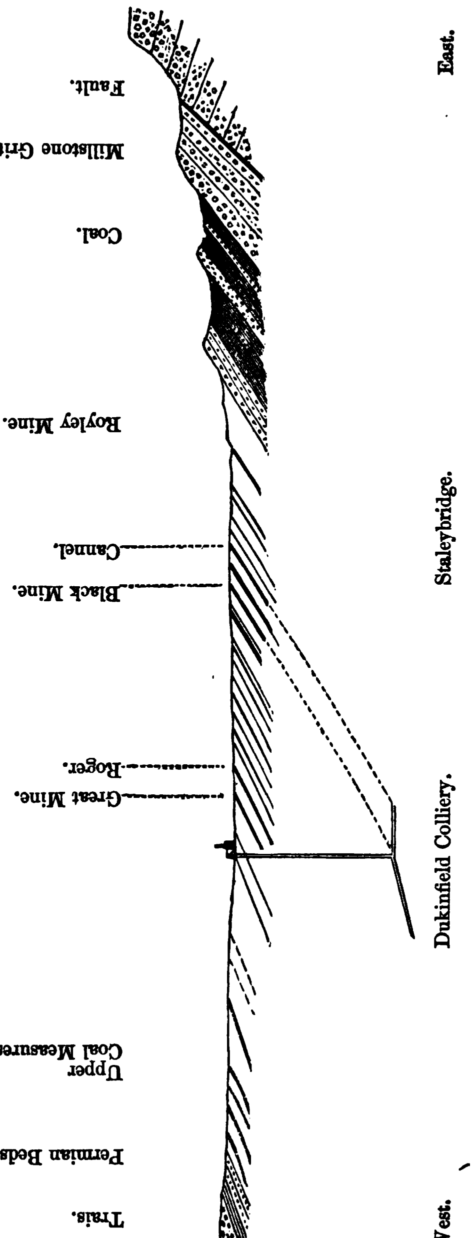
The uppermost workable seams are the *Great Mine* and *Roger*, both thick and moderately good coals; but owing to the small extent of surface which they occupy, they have not as yet been largely worked.

After crossing into Cheshire, the coal-field begins to contract in breadth, and ultimately ends off in a point in the direction of Macclesfield. This is owing to the existence of a large fault, which throws in the New Red Sandstone on the west against the Coal-measures which gradually rise and crop out southwards until ultimately the millstone grit reaches the surface. The vertical displacement of this fault must be several thousand feet, if not yards.

Having concluded our short account of the principal coal-seams, it may not be altogether useless or uninteresting to point out some of the districts where the coal lies for the most part undisturbed, and to

FIG. 2.

SECTION ILLUSTRATING THE GENERAL ARRANGEMENT OF THE FORMATION ALONG THE EAST SIDE OF THE LANCASHIRE COAL FIELD, AND THE WORKINGS AT DUKINFIELD COLLIERY.



which we may look for the future supply, when the mineral shall have been more or less exhausted in those localities where it is at present most largely mined. We shall presently offer some details, showing that the exhaustion is proceeding with accelerated speed, and it therefore becomes a question of importance, whether there are still remaining certain tracts as yet unopened up, where the coal may be found at a future day within workable depths.

We are glad to be able to state that as far as the Lancashire coal-field is concerned, there are several districts of considerable extent, where some of the most valuable seams lie in all their primeval integrity, at depths within a thousand yards, and therefore certainly available. That which is best known and appreciated is the belt of country lying to the north of the Mersey, and forming the southern limit of the coal-field. Although formed of New Red Sandstone and Permian strata, it is well known that the coal-seams dip under these newer formations, and have in several collieries actually been worked underneath. Of these we may mention the collieries of Haydock, Edge Green, Astley, Bedford, and Patricroft. It will, however, in all probability, be a long period before the New Red Sandstone is extensively invaded by coal-pits.

One of the most important districts for future supply is that which lies to the south and south-east of St. Helen's, and extends as far as the Railway Junction in the direction of the dip of the beds. At this deepest point the vertical distance to the St. Helen's Main Coal would be a little over 1,000 yards; and at every step nearer St. Helen's the depth would be lessened.

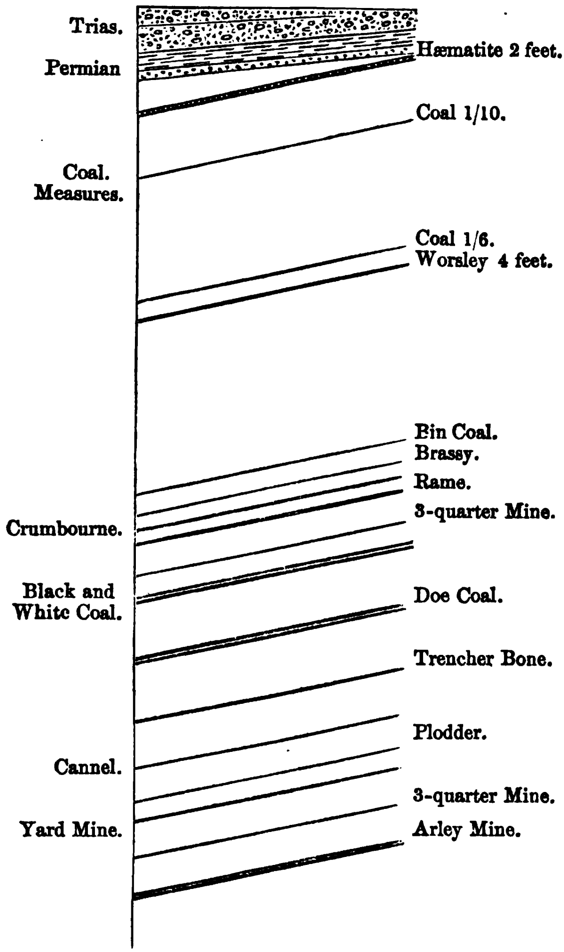
In the Wigan district, besides the "deep belts," in which the Arley Mine lies at a depth of 1,000 yards and upwards, with several shallower seams of great value, at still smaller depths, there is, also, the tract lying between Standish and Coppul, which has been very little explored, and which contains three or four seams of workable coal.

There is a considerable tract of virgin ground formed of upper coal-measures around Abram, and extending as far east as the great fault west of Bickershaw Colliery. Here several seams would be found at depths under 1,000 yards. Between Bickershaw Higher Hall and West Leigh Hall, there is another tract of upwards of a square mile in extent, where the coal lies as yet undisturbed. This band of coal-measures extends as far west as the large fault just referred to, which introduces the New Red Sandstone.

Perhaps the most important band of country for future coal supply is that which stretches on either side of the outcrop of the Worsley 4-feet seam, from the great fault which runs within half a mile to the N.E. of Leigh and Bedford to Monton, a distance from west to east of six miles. Over every portion of this tract, *on the north side of the outcrop of the Worsley 4-feet Mine*, all the seams, including the *Arley Mine*, may be reached at depths within 1,000 yards. South of this outcrop none of the underlying coal-seams have as yet been touched; and there is, therefore, an area of about 10 square miles, in which the 4-*feet* coal lies at a depth considerably under 700 yards, and several deeper seams, such as the *Rams Mine*, under 1,000 yards. Many of these seams may be worked (as already hinted) under the New Red Sandstone, which runs for the most part parallel to the trend - "levels" of the coal-seams in this district.

FIG. 3.

GENERAL SECTION, SHEWING THE SUCCESSION OF THE COAL SERIES WEST OF MANCHESTER.



Proceeding eastward, the next district of reserve of special importance is that which lies along the northern outcrop or border of the New Red Sandstone and Permian strata from Ringley to Prestwich, and some distance further eastward. This tract is much obscured by sand and clay, so that the strata are rarely visible even in deep brook courses. Still, judging from the southerly dip of the coal-seams which reach the surface along the banks of the Irwell, as far east as Radcliffe Bridge, there can be little doubt that this district is full of coal. The construction of shafts will, probably, be attended with much difficulty and expense, owing to the depth of the running sand.

The Manchester coal-field ought, according to all the recognized principles of stratigraphical succession, to contain a vast supply

of coal below the seams now being worked; but from some unexplained cause these have never been reached in the trial-borings which have been made.

To the north and east of the margin of the New Red Sandstone, from Middleton to Denton, there runs a band of about ten square miles, stored with all the coal-seams of Oldham, Ashton and Dukinfield, but at greater depths as being further removed from the outcrop. On this tract is situated Mostyn Colliery, at which the upper *Great Mine* is worked at a less depth than 300 yards; consequently the *Black Mine* would be found at less than 1,000 yards at this spot, and throughout the greater part of this band of coal-measures the dip is likely to be found rather steep, and the ground considerably broken by faults.

There are, therefore, from 30 to 35 square miles of what may be considered as reserve-ground, plentifully stored with coal at depths varying from 2,000 to 4,000 feet, which is as yet scarcely broached.

FAULTS OR DISLOCATIONS.

The Lancashire coal-field is remarkable for the magnitude of the lines of fracture by which it is traversed, and in some parts bounded. The western boundary of the coal-field is a large fault, which throws in the New Red Sandstone along a line ranging from Lathom Park on the north, by Bickerstaffe and Knowsley Hall to Huyton and Tarbock. The throw of this fault may probably reach 1,000 yards in some places.

The "Great Up-Holland" fault, which ranges north and south by Pimbo Lane, has a throw of 700 yards. The effect of this dislocation is to reintroduce a large area of coal-ground to the west of its outcrop at Billinge, Orrell and Up-Holland. On this area—which is the nearest collieries to Southport and the northern suburbs of Liverpool—are situated the collieries of Rainford, Blaguegate, Swifts' Folds, Skelmersdale and Holland.

Of the five great parallel faults which traverse the Wigan district, the "Pemberton Fault" has a throw of 470 yards at Tan House Colliery; the "Shevington Fault" of 600 yards opposite the John Pit of the Kirkless Hall Company; the "Giant's Hall Fault" of 600 yards, west of Ince Hall Colliery; the "Standish Fault" of 160 yards at Amberswood Colliery; and the "Great Haigh Fault" of 600 yards near Kirkless Hall Colliery. In general, notwithstanding the magnitude of the vertical displacement occasioned by these great fractures, they are remarkably "clean," very little broken or barren ground being found on either side of them. They have proved of immense benefit to the mining operations of the district, as they form natural barriers for damming the waters in old workings. On this account great precautions are taken by colliery owners on both sides, that the natural sluices may not be cut through.

The Worsley district is traversed by three parallel faults varying east and west in the same direction as the outcrop of the coal-seams. The most southerly of these may be traced over five miles; the others for a less distance. The effect of these faults is to *repeat* several of the same seams twice, or thrice; so that in traversing the district from south to north (in the direction of the dip and rise) we

pass over the outcrop of the same strata twice or three times, according to position. The celebrated navigable tunnel, constructed by the great Duke of Bridgewater, traverses these strata. Entering the hill-side at the village of Worsley, where it joins the Bridgewater canal, it takes a NN.W. direction for a distance of nearly four miles, never again reaching the light, but communicating with the surface by several colliery shafts which are sunk close by its side. At its northern end it is about 285 feet from the ground. Its purpose was to serve, we believe, both as a means for draining the mines, and to afford canal transit for the coal direct from the galleries of the mines to the Liverpool and Manchester markets. The railway in course of construction across this part of the coal-field will probably render this underground canal of small economic value, but we cannot but admire the spirit of enterprise which prompted the execution of a work at once so costly and difficult.

The "Great Irwell Valley fault," which traverses the centre of Bolton and Manchester, has a down-throw to the north-east of upwards of 1,000 yards at Ringley: the amount of displacement being capable of demonstration from the position of the coal-seams on each side.

The fault which cuts off the strata of the Manchester coal-field on the west against the New Red Sandstone on the east, has a throw probably little short of 1,000 yards, and several others of very large displacement occur near Bury and Oldham. The direction of the majority of the great faults ranges north-west or NN.W., and they slope or hade very considerably. The average slope may be taken at 2 vertical to 1 horizontal of 25°; but there are instances of the slope being nearly as much as 2 horizontal to 1 vertical. This would appear to indicate that the fault had been produced principally through the influence of lateral tension, as it may probably be assumed that the amount of obliquity of any fault or system of faults from the vertical is in proportion to the horizontal pressure or tension. Their practical effect, however, is to render the position of each fault variable in different coal-workings. Thus we may find the same fault traced on the plan of a shallow seam at the horizontal distance of a hundred yards from its position in a deep seam; but if care be taken to mark the side of the downthrow, and proper allowance be made for the slope, all errors on this score may be avoided.

IRON ORES.

It is remarkable that there is not a single band of clay-iron stone at present employed for the extraction of iron in Lancashire: of blast-furnaces situated on the Lancashire and Cheshire coal-field, those belonging to the Kirkless Hall Company near Wigan are the only instances, and they are supplied with Ulverston ore, mixed with a little calcareous hæmatite from the upper coal-measures of Patricroft, near Manchester; of which we shall speak presently. The only instances we are acquainted with in which the argillaceous carbonates of the coal-measures have been used for smelting, are those which once existed near Burnley, at Haigh near Wigan, at Dukinfield, in Cheshire (which belonged to Messrs. Swire and Company), and at a place called Tunshill, near

Rochdale, in which a large sum of money was sunk with very little return. All these works are now extinct, and so long as the rich ores of Ulverston, Furness, and Cleator Moor are to be had in such abundance as at present, they are not likely to be revived.

The Lancashire coal-field is not, however, to be regarded as destitute of workable iron-stones. Throughout the whole of the lower, middle and upper series these ores are to be found, but especially amongst the upper series; some of them resembling the "black-bands" of other districts. We would particularly call attention to the instances of nodular or banded ironstones, which occur above the *Arley Mine*, north of Heywood; also to those which are shown in the banks of the Irwell, at Ashclough, and north of Clifton House; also to specimens shown in the brook below Seddon House, and which crop out along Haigh Wood, near Wigan, lying amongst the *Ince Mines.* There are also the bands which lie below the *Pemberton 5-feet Mine,* which have been worked by Mr. Stephens, of Pemberton; the black-band above the *cannel* of Wigan; and the carbonaceous black-band below the *Pendleton 4-feet coal,* found in sinking Mr. Fitzgerald's new pits, which is about 4 feet in thickness.* This latter has been analyzed by Mr. J. Leigh, F.C.S., and gave the following results, in 200 parts of average sample :—

Water	4.0
Bituminous matter and carbon	98.0
Silica	29.3
Silicates of iron, alumina, and lime	3.2
Alumina	4.5
Carbonate of lime	3.4
Peroxide of iron	57.0
Loss	0.6
	200.0

This would only produce about 20 per cent. of metallic iron, and cannot be regarded as a rich ore.

The most valuable band is that which is now being worked at Patricroft by Mr. Lancaster, and supplied to the Kirkless Hall furnaces, as it is found to mix well with the purer ore of Ulverston: the large proportion of carbonate of lime which it contains, amounting to about 40 per cent., enabling it to act as a flux. It occurs as a bed, dipping with the strata towards the south at a moderate angle. In thickness it is about 2 feet, sometimes less, and it is in the state either of a greyish carbonate or of a red-coloured peroxide. It yields from 22 to 26 per cent. of metallic iron, and is generally free from phosphorus or sulphur.

This band has, doubtless, a considerable horizontal range, but is concealed beneath the Permian and New Red Sandstone at Patricroft and all along the southern margin of the coal-field. In consequence of this it never actually reaches the surface west of Manchester, but irses at an angle of about 10° and strikes against the bottom of those newer formations which creep over the carboniferous strata at a more moderate angle. The same band may be observed in the banks of

* Mr. E. W. Binney, *On the Deposits of Iron-stone in Lancashire.* Mem. Phil. Soc. Manchester, vol. xii.

the Medlock at Ardwick, on the east side of Manchester, where the thickness appears to be rather less than at Patricroft. It is at this point in close proximity to the limestones of the upper coal-field, and we see no reason to doubt the practicability of raising and smelting the ore here with profit. The pig-iron would command a ready market amongst the large foundries of the neighbourhood.*

Progress of Mining Operations in Lancashire and Cheshire.—In a communication made to the Philosophical Society of Manchester, in March, 1854, Mr. Joseph Dickinson, inspector of coal mines, gave certain statistical returns regarding coal-mining in Lancashire and Cheshire, which, if compared with similar returns for 1860, from the "Mineral Statistics of Great Britain," by Mr. R. Hunt, of the Mining Record Office, will show the state of this branch of industry at the present day as compared with that seven years since.

Number of Collieries.—In 1853 there were 362 collieries, of which 28 belonged to Cheshire, and 334 to Lancashire; there are now 406, of which 35 are in Cheshire, and 371 in Lancashire; being an increase at the rate of 6.28 yearly. The actual number of new collieries opened each year is greater than this, as the figures represent the surplus of those opened above those which were closed.

PRODUCE OF COAL.

	1836. Estimate of Mr. Elias Hall. Tons.	1852. (Mr. Dickenson.) Tons.	1860. (Mineral Statistics.) Tons.
Lancashire ..	3,176,000	8,255,000	11,350,000
Cheshire	224,120	715,000	750,500
Total ...	3,400,120	8,970,000	12,100,500

Assuming the correctness of these estimates, we see that the increase from 1836 to 1852 has been 5,569,880 tons, or at the rate of 347,492 tons yearly; and from 1852 to 1860 it has been 3,130,500 tons, or at the rate of 392,562 tons yearly: so that the production has been governed by an accelerated rate of increase. Of this enormous quantity of coal nearly one million of tons is shipped to ports of the United Kingdom and foreign parts; a large quantity is sent southwards by the London and North Western Railway; but probably 9-10ths of the whole is consumed within the limits of the county.

The number of persons employed at the collieries, both above and under ground, in 1852, was 33,600, and may now be estimated at 43,000 in 1860.†

It is evident, from the above figures, that the annual production of coal is increasing with giant strides. The increase for the year 1860

* This band of ore was first identified with that of Patricroft by Mr. E. W. Binney, who has called attention to the importance of its occurrence in this neighbourhood. Trans. Geol. Soc. Manchester, vol. i.

† In some of the above estimates the Burnley coal-field is included. We had intended giving a special description of this small but rich basin, but, owing to the length the paper has already attained, feel it necessary to postpone this part of our subject. There are already two very complete notices of the Burnley coal-field; one by Messrs. Whitaker and Wilkinson, in "The Geologist," vol. iv., No. 47; the other by myself, in "The Coal-fields of Great Britain," 2nd edit., p. 132.

was nearly one and a half millions of tons over the produce of the previous year. The line of railway now in course of construction from Wigan to Patricroft, and which crosses one of the richest tracts of the whole coal-field, will probably add to the ordinary increase one million of tons for the year upon which it is opened. It is therefore almost certain that in a very few years the annual production will reach 15 millions of tons. Whether it will exceed this is a question we leave to events to show, but we do not apprehend a much greater increase than this. It is evident that the production of this or any coal-field which constantly tends to increase, must ultimately reach a maximum to be determined (supposing the demand and the necessary agency are forthcoming) by the capabilities of the coal-field itself. If the productive ground is fully occupied by collieries, each in full work, then the yield will have reached its maximum. The Lancashire coal-field is far from approaching such a state; but there are certain districts, of which St. Helen's, Wigan, Oldham and Ashton are the centres, where the coal is being rapidly exhausted; and, in proportion as the seams have to be followed from the outcrop in the direction of the dip, so must the number of the collieries decrease, and many seams be left behind which at small depths would have been workable. On these grounds we do not look forward to any very great advance in the quantity of coal annually to be raised in Lancashire.

The estimate of the resources of this coal-field (including that of Burnley), made by myself,* puts us in possession of data for determining with approximate accuracy the possible duration of the supply. I make the total quantity of coal still remaining, and within a vertical depth of 4,000 feet, to reach 3,990 millions of tons, which, at the rate of production for 1860, would be sufficient to last for 330 years. This, however, is the most favourable view of the subject; for should the annual quantity raised reach 15 millions of tons, the period would be reduced to 266 years; and, should 4,000 feet be found a depth too great for mining operations, this period will be still further shortened. In point of fact, however, the coal field can never be exhausted *suddenly*. In the ordinary course of events the production must gradually decline after the maximum has been reached, just as it has gradually augmented up to that maximum.

NOTE.—Mr. Elias Hall, in the year 1836, made an estimate of the resources of the coal-field, which, with proper modifications, agrees remarkably with and thus verifies my own. Neglecting what he calls "the lower and middle coal-fields," which include all the seams of the millstone grit, and lower coal-measures below the *Arley Mine*, he makes the quantity in the "Upper Coal-field" (including all the seams from the *Arley Mine* upwards) to reach 7,124,480,000 tons, to which is added for the Burnley coal-field 70,212,266: in all, 7,194,692,266 tons. He deducts one-fifth for pillars, &c., and 131,203,413 tons for the quantity worked out; leaving 5,624,550,400 tons. From this we must deduct 240,000,000 for the quantity raised

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* "The Coal-fields of Great Britain," p. 135.

since 1836, and one-third of the remainder for seams which would be unworkable at depths over 2,000 feet. This leaves the available supply at 3,589,700,267 tons, which, it will be observed, is very near the estimate given above. I have been unable, however, to ascertain Mr. Hall's limit of depth.

On the Mexican Method of Amalgamation.

By JAMES NAPIER, JUN., F.C.S.,
Late Chemist and Assayer to the Guanaxuato Mint, Mexico.

§ I.—INTRODUCTION.

BEFORE proceeding to describe in detail the Mexican method of amalgamating silver ores—which will principally apply to those which came under my own observation at Guanaxuato—I propose making a few introductory remarks on the history of the Patio amalgamation process, and on the composition of the ores characteristic of some of the different districts.

The ancients were well acquainted with the property which mercury has of combining with gold and silver, and took advantage of the fact for removing gold from old apparel by first burning them to ashes in an earthen pot and then amalgamating them. Humboldt also states that, before the discovery of America, the Germans employed mercury to extract gold from auriferous sands as well as from iron and copper pyrites; but we have no knowledge of mercury having been employed for the purpose of extracting silver from its ores before the year 1557, when Bartolomé Medina, a miner of Pachuca, in the neighbourhood of Real del Monte, in Mexico, discovered the "Patio" method of amalgamation. It is very difficult to form any correct idea as to how this wonderful process was invented, and what it was that led to the discovery. It could not have been by chemical reasoning that Medina mixed the various ingredients—sulphate of copper, (magistral) salt and mercury—with the minerals of silver to extract the metal; and the discovery appears more extraordinary when we consider that the process requires weeks and even months for its completion, so that a long time had to elapse before the result of an experiment could be obtained. We can only suppose that Medina, being aware of the property which mercury has of combining with silver and forming amalgam—and also knowing that anhydrous sulphate of copper (obtained by calcining copper pyrites) when immersed in water gives out heat—conceived that if these were mixed with silver ore and common salt (which was thought to have a cleaning effect on the silver previous to its combining with the mercury), that the heat caused by the sulphate of copper would favour the amalgamation. Although this process requires a long time for its completion, the operation of reduction commences almost at once, so that by taking

out trials soon after the incorporation of the mass it could be seen that the mercury was taking up silver; and it would be easy to know, by burning at intervals a weighed portion of the amalgam, how much silver the whole quantity of mercury added would contain, and when the process was completed.

In 1586, a Peruvian miner of the name of Carlos Corso de Leca discovered what has been termed "*el beneficio de hierro*" (the reduction by iron). This consisted in adding to the *torta* small pieces of metallic iron, the object of which was to save mercury, which it would do by reducing the chloride of silver; but I am not aware of this process ever having been worked to any extent.

The next improvement made was by Alonzo Barba, in 1590. It consisted in amalgamating in large copper pans, heated from below, and was called "*el beneficio de caso y cocimiento.*" In this process there was a great saving of mercury, but a large consumption of copper, as the chloride of silver was reduced at the expense of the copper pans; it answers very well for the native chlorides, but not for sulphides of silver. In 1784, this process was introduced into Europe by Baron de Born, an Austrian mining officer, and from it has sprung the barrel amalgamation of Freiberg, proposed, I believe, by Gellert. So that from the process first invented by Medina, in Mexico, has sprung all others for amalgamating silver ores; and although his original process has undergone many alterations, the principle still remains the same.

Silver Ores of a few of the districts of Mexico.—I believe that every known ore of silver has been met with in some one or other of the numerous mineral districts of Mexico, but many districts have ores peculiar to themselves, and all ores will not yield their silver by the "patio" amalgamation.

Perhaps the ores of *Guanaxuato* yield their silver by the *patio* amalgamation better than those of other districts, from the fact of their containing but few foreign metals; the silver being mostly found in the form of pure sulphides, in many instances in carbonate of lime and quartz veins. The following shows an analysis of an ore from the district of "La Luz," in Guanaxuato :—

Silica	75·00
Silver	1·04
Iron	4·71
Carbonate of lime	8·25
,, magnesia	3·26
Sulphur	6·79
Copper	·55
	99·60

This, however, is not to be considered by any means as an average sample of ore from this district, for the average richness of the ores produced here will probably not exceed from 45 to 60 ounces of silver per ton. Nearly the whole of the ores of this locality contain gold in various proportions. To show what proportion the gold bears to the silver, we subjoin the coinage of the mint of Guanaxuato for ten years, commencing at 1850.

COINAGE OF THE GUANAXUATO MINT FOR 10 YEARS.

Year.	Gold $	Silver $	Total $	Per Centage of Gold.
1850	709,472	7,801,300	8,510,772	8.336
1851	606,022	7,011,750	7,617,772	7.955
1852	746,956	7,625,650	8,372,606	8.921
1853	723,078	6,235,922	6,969,000	10.375
1854	450,288	5,029,712	5,480,000	8.216
1855	555,200	4,698,800	5,254,000	10.567
1856	479,476	4,306,524	4,786,000	10.018
1857	570,700	4,747,300	5,318,000	10.731
1858	489,744	4,725,256	5,215,000	9.391
1859	438,880	5,046,120	5,485,000	8.001

The ores of *Zacatecas* frequently contain argentiferous blende, which makes them rather more difficult to work than those of Guanaxuato. Gold was almost unknown in the mines of Zacatecas until 1856, when a vein was cut in the mine of the "Bote" containing large quantities of gold, which still continues to yield a considerable produce of that metal.

Real del Monte produces ores of a very various nature, some containing considerable quantities of manganese; as the following analysis of a sample by Mr. Rodgers, from the Santa Brigida vein in that district, will show*:—

Silica	68.00
Alumina	8.00
Peroxide and sulphide of iron	7.50
Magnesia	1.60
Sulphide of lead	2.82
Peroxide of manganese	5.30
Sulphide of zinc	2.30
Lime	1.45
Sulphide of copper	.40
Silver	.25
Potash, antimony, tellurium, traces of soda, gold and loss	2.38
	100.00

My late lamented friend Mr. Edward Louckner, who has examined these and similar ores very carefully, states that the silver in many cases exists as a manganate. The ores from the various mines of this locality differ very much in their nature and composition, and have consequently to be reduced by different methods: some are reduced by *patio*, others by barrel amalgamation, and some are smelted. Some

* See description of the Silver Mines and Amalgamation Process of Mexico, by John Phillips, Esq.

of the silver produced here contains sufficient gold to make its extraction a matter of importance.

In the district of *Anganqueo* the silver exists mostly combined with blende and sulphide of lead, and is reduced by smelting. The following analysis shows its composition :—

Zinc	52.09
Sulphur	32.00
Iron	13.44
Antimony	2.40
Silver	97
	100.9

In *Fresnillo* the ores worked do not perhaps exceed from 16 to 24 ounces of silver per ton, but the quantity operated upon is very large indeed, being about six thousand cargas* weekly : the grinding is partly carried on by steam power. There is but one reduction works in this locality, but it is the largest of its kind in the world. The ores contain no gold.

The district of *Catorce*, although now yielding comparatively little ore, formerly gave very large quantities of chloride, bromide and iodide of silver. These were reduced to a great extent by the "*Caso* process," or in copper pans. A large quantity of the ore from this district is also smelted in small blast furnaces. The ores contain no gold.

In the district of *Reyes* the ores differ very much in composition, as may be seen from the following analyses :—

	First.		Second.
Silica	50.000	Silica	24·00
Sulphide of iron ...	26·521	Lead	38·44
" silver ..	·150	Silver	2·75
" lead ...	2·076	Iron	6·50
" arsenic	·100	Antimony	15·17
" zinc ...	5·000	Sulphur	14·00
Sulphate of iron ..	·258		
" lime ...	·430		100·86
Oxide of manganese	3·540		
Carbonate of lime	4·160		
" magnesia	·960		
Moisture	6·800		
	99·995		

Some of the antimony in the second analysis existed as red sulphide. The first analysis may be taken as an average of the ores worked in this locality, although very frequently antimony is also found in various proportions. By the *Patio* amalgamation not more than from one-half to three-quarters of the silver can be obtained from these ores, and this only with a large loss of mercury. In examining various samples from this district, we have found part of the silver to

* A carga is equal to 300lbs.

exist in the form of *silicate*, which it is difficult to separate except by smelting; and the ores in general are not sufficiently rich to admit of this process being adopted where charcoal is so very expensive and scarce.

In the district of *Jalpa* a very interesting mineral of silver has been found, which, according to R. Richter, has the following composition:—

Silver	71·51
Copper	3·12
Iron	1·79
Sulphur	14·36
	99·68

Affording the formula ($\frac{3}{4}$ Ag + $\frac{1}{2}$ Cu)S. It has a lead-gray colour, and is malleable like ordinary silver-glance. Cleavage monometric, specific gravity 6·877 to 6·890. Breithaupt has given it the name of *Jalpaite*. (*American Journal of Science*, 2 ser., vol. xxvi. p. 358.)

In many of the mineral districts of Mexico there are thousands of tons of low-class ores which would not pay the cost of amalgamation. Various plans and apparatus have been proposed from time to time for concentrating these by washing, but up to the present time we know of none which has proved effective. Some of the machines have exhibited much skill on the part of the inventors, and for many classes of ores I have no doubt they might answer admirably. To concentrate these ores they would first have to be very finely ground, because the sulphide of silver is very intimately mixed with the gangue, and this operation is a very expensive one in Mexico, having to be done by animal power. Besides, in grinding, the sulphide being softer than the gangue, becomes so fine that the portion which passes away in the water used for washing contains in many instances as much, and sometimes more, silver than the portion remaining behind.

It may not be out of place just to remark here, that besides its wealth in silver, Mexico is much richer than is generally supposed to be the case in other metallic minerals. In the present condition of the country these are of course quite unavailable; but they present the elements of great future prosperity when law and order are restored, and proper security given to induce the application of the necessary capital to make them available. Many of these ores are distinctive in their composition, and are little known in Europe.

Government Aid to Science Instruction.

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It is not yet generally known that a powerful impulse to scientific instruction in this country has lately been given by a system of government aid. Although at present in its infancy, the experiment has already been attended with important results. The arrangements are conducted by the Science and Art Department of the Committee of Council on Education,

in conjunction with local committees of not less than five well-known responsible persons. The Department of Science and Art holds in May of each year a public examination in every locality throughout the United Kingdom which complies with the requisite conditions. The examiners include most of the professors at the Government School of Mines, and several other eminent men of science. Mr. Warington W. Smyth, M.A., F.R.S., is the examiner in the subjects of Mineralogy and Mining; and Professor Ramsay, F.R.S., holds the same position with regard to Geology. The position of the examiners is therefore such as to give weight and authority to the results of the examination. This is very necessary in order that employers of labour should have confidence in the results where they are presented as tokens of efficiency.

The following are the branches of science which form the subjects of examination:—

1. Geometry, Mechanical Drawing, and Building Construction.
2. Mechanical Physics.
3. Experimental Physics.
4. Chemistry.
5. Geology, Mineralogy, and Mining.
6. Animal Physiology and Zoology.
7. Vegetable Physiology and Botany.

The character of the examinations may be judged of by the following questions selected from the examination papers of May last.

Geology.

4. How would you detect that a rock is limestone?

5. What is a conglomerate rock?

9. Construct a *vertical column* showing the chief British geological formations.

12. Of what materials has coal been formed?

13. How does coal lie among the strata, *and how was it formed?* and what metallic ore is worked to a great extent in the coal measures?

14. If a *trap dyke* (say of basalt or greenstone) is found to pass through coal measures, *what effect* would you expect it to produce on the beds of *coal* that it passes through?

15. What is a fault?

17. In what manner do copper, tin, and lead ores chiefly occur in the British rocks?

21. Name some of the *genera* or species of fossils found in the *carboniferous rocks*, viz., the *carboniferous* or *mountain limestone*, and the *coal measures.*

Mineralogy.

2. How are the different degrees of hardness of minerals best compared?

4. Give a full description of the physical and chemical characters of iron pyrites, mentioning its local appellations and the uses to which it is applied.

10. From what various minerals and localities is sulphur obtained?

12. Name and describe two of the most important zinc ores.

Mining.

2. What are the character and constituents of fire-damp?

3. State the circumstances in a colliery under which a Davy lamp ceases to be safe.

5. In what geological formations are the more remarkable repositories of copper ore worked?

7. State the principles of natural ventilation in mines.

10. What is the principle and construction of the plunger-pump or ram used in mines?

11. Describe the best method of blasting in hard rock.

12. Describe the method of "stoping" a vein, or of working coal in the district with which you are acquainted.

The above selection will show that the examinations are of an eminently practical character, and that they require such a knowledge as must be exceedingly useful to the miner. Several mining schools have consequently availed themselves of the opportunities thus offered.

The aid granted by the department is in the form of—

1. Payments to certificated teachers in charge of science schools and classes. The payments depend on the results of the examinations.
2. Grants towards the purchase of apparatus, diagrams, &c.
3. Prizes of books and medals to those candidates who obtain creditable positions in the examination lists. These prizes are granted, whether the teacher of the school be certificated or not, and they may be obtained by candidates who have not attended the school. The medals are, one gold, two silver, and three bronze, given to the six most successful candidates in each subject throughout the kingdom, if the degree of their proficiency be sufficiently high. The list of books from which the "Queen's Prizes" might be selected for the examination of May last included Brooke and Miller's "Mineralogy," De la Beche's "Geological Observer," Lyell's "Principles of Geology," Lyell's "Elements of Geology," Owen's "Palæontology," Hedley's "Working of Coal Mines," Phillips's "Metallurgy," &c., &c.

From returns recently published, it appears that at the examination held in May last, pupils from the following schools obtained prizes :—

Bristol Mining School	... ...	10 prizes.
Wigan Mining School	... ...	18 "
Cornwall and Devon Miners' Association		29 "

Two silver medals were awarded to Wigan, and one to the last-named institution. The Bristol Trade School (for boys) obtained no less than 57 prizes, one silver, and three bronze medals. The Andersonian University, Glasgow, obtained 7 prizes.

The scheme, of which the foregoing is an outline, is evidently susceptible of an enormous development. It may be made the means of conveying into mining districts some portion of that sound scientific instruction, which, while not in the slightest degree taking the place of practical experience, is yet a most important and necessary aid to the latter. It is to the officers of mines that the advantages of the arrangements are chiefly open; and even to those who do not care to go under instruction, they supply a means of obtaining a recognition of their scientific abilities. Whether the scheme be calculated to benefit the working miner to any considerable extent may perhaps form the subject of a future inquiry.

Abstracts and Reviews.

COMMERCIAL DETAILS CONCERNING COPPER SMELTING.

(From Dr. Percy's "Metallurgy.")

Freights.—Freight from Cornwall for all descriptions of copper ores was 3*s*. 6*d*. per ton, September, 1859. Formerly, this charge, inclusive of carriage from the mines to port, was 10*s*. per ton of ore delivered at the works; whereas, at present, these two charges average about 6*s*. 6*d*. per ton.

Freight of copper ore from Cuba to Swansea varies from £2. 10*s*. to £2. 15*s*. per ton of 20 cwts. Freight from Callao, South America, has been as low as £1. 16*s*.; in September, 1859, it was £3. 5*s*., and outward to the same port £1. 17*s*. The Cuba freights are constant, and do not—like those from South America—vary with the price of copper. My authority for this information is Mr. Nicholson, who is largely engaged in the shipping trade between Swansea and South America.

Weights by which copper ore is sold.—The ore is sold in England by the ton of 21 cwts. (of 112 lbs. to the cwt., *i.e.*, 2,352 lbs. to the ton), estimated *dry;* but, if it is imported from abroad, it is the custom to allow the buyer 24½ lbs. per 21 cwts., *i.e.*, 2,376½ lbs. to the ton.

Cost of the Welsh method of copper-smelting.—There is reason to believe that metallurgical treatises and papers frequently contain statements as to the cost of production which are very erroneous, and may seriously mislead inexperienced persons. Not long ago it was gravely declared, at a meeting of the Society of Arts, that the average profits of copper-smelting were not less than 40 per cent. on the capital; and during the present year (1861) advertisements have appeared in the *Times*, under the sanction of respectable names, announcing the formation of a great Copper-Smelting Company with not less than £10,000,000 capital, and inviting subscriptions on the ground that 30 per cent. profit might be easily anticipated. The scheme may have been put forth *bonâ fide*, but I doubt not that its promoters were mistaken in their estimate.

No reliable *general* estimate of the cost of *smelting* copper can be furnished, as it must of necessity vary with the ever-varying cost of fuel, labour, iron, fire-brick and other materials; and this variation applies even to any particular works at different periods, while scarcely any two works are precisely similarly circumstanced. Thus at one establishment fuel now costs nearly double what it did some years ago at the pit's mouth, and wages are at least 10 per cent. higher. Then the cost of smelting a particular kind of ore varies much with the circumstances of the smelter's stock; at one period calcination may be saved by fortunate concurrence of another description of ore; and not only so, but the admixture be productive of cleaner than ordinary slag. On the other hand, every process may have to be encountered, and the result as to slag may be unsatisfactory. Besides, there is the cost of pulling down furnaces and the breaking up of furnace bottoms, and the conversion of their contents into marketable copper, together with many other uncertain contingencies constantly recurring in all large establishments of this nature, which make it impossible to offer a reliable general estimate. Nothing, in fact, short of an examination of a smelter's accounts would be any guide in a commercial point of view, and not even that unless the quantity of ore of each kind and its percentage of copper were set forth. But if the matter is looked at commercially, it will be perceived at once how little to be relied upon any such general estimate can be. Large quantities of copper ore are bought at the mines and carried at the smelter's expense to a shipping port. From one mine the carriage may be three shillings per ton, from another ten shillings; then there is freight to the landing place; and at one establishment the ore may be landed nearly at the furnace mouth, at another it may have to be transhipped into barges or loaded into railway waggons at an extra cost of some shillings per ton. Again, one smelter's furnaces may be near his market for copper, another's more distant, when transport becomes more costly. By way of example, it may be stated that in one case the cost of conveying copper to market, the cost of agency in selling it, and the discount allowed to purchasers for prompt payment, equalled the cost of making copper from some richer descriptions of ore.

Le Play has entered into elaborate calculations concerning the cost of smelting copper by the Welsh method; but, as it does not appear that he had access to the balance-sheets of the establishment in which he was permitted to study the process, the results at which he arrived cannot be received as authoritative. It seems hardly possible that any person, however perfect his knowledge may be of the theory and practice of copper-smelting, and however shrewd and expert he may be as an accountant, should be able to deduce with certainty the cost of production from the data which may be collected in works by personal inspection or elicited from workmen. From information on this subject which Le Play obtained at Swansea, he was led

to conclude that copper-smelting might be profitably conducted at Caronte, near Marseilles; and, for various reasons which he enumerates, he advised the erection of copper-works in that locality. He, moreover, expressed an opinion that there was no other locality in Europe in which the metallurgical treatment of copper ores by the *wet way* might be attempted with greater prospect of success.* In consequence of the publication of these opinions by Le Play, not fewer than four establishments for the extraction of copper were erected near Marseilles, known as the Usines de Caronte, de Rouet, de Septèmes, and de Bouc. The latter was destroyed in 1854, and in 1858 all had become defunct. The following comment appears in a notice of these works by Simonin.† "The particular position of Caroute had been indicated as the best for works in the south of France by an illustrious engineer, whose eminent talents have shed so great a lustre on the study of metallurgy, and especially on the metallurgy of copper—M. Le Play. But now the experience of years has destroyed illusions prematurely, perhaps, conceived, and the important problem of the treatment of copper ores in France appears beset with difficulties [et la question avantageuse du traitement du cuivre en France parait environnée d'écueils] except possibly in cases altogether exceptional."

A method intermediate between the Welsh and continental methods, similar to that recommended by Le Play,‡ was practised at these works. Both blast and reverberatory furnaces were employed. A notice of the *wet* method, which was also tried at Le Play's suggestion, is given at page 450.

Sir W. Logan's formula of the cost of copper smelting.—Sir W. Logan informs me that, when formerly engaged in copper smelting, he ascertained with great care the exact cost of each operation, and deduced the following formulæ for calculating the total cost of the entire process with ores of varying produce, namely, 10*s.* per ton of ore, with the addition of 2*s.* for every unit, *i.e.* 1 per cent., of produce as determined by the Cornish method of assaying. This formula comprises all expenses from the purchase of the ore (exclusive of Cornish carriage) to the refining of the copper inclusive; and he assured me that he found it applicable to all ores without exception. But it is obvious that it must vary with the *price of labour and fuel;* and both the important items of expenditure have advanced considerably since the days when Sir William, in conjunction with Mr. Starling Benson, carried on the business of copper-smelting. In conversing with a copper-smelter not long ago respecting the formula in question, he expressed his opinion that with 1*s.* 9*d.* instead of 2*s.* per unit of produce, a more correct estimate would be obtained. I have recently had the opportunity of inspecting an actual balance-sheet of one of the largest firms at Swansea, and I found that the formula, with the modification just mentioned, gave very nearly the same sum as charged in this balance-sheet for smelting costs. Supposing the average produce of the ores smelted to be 8 per cent., the cost of smelting one ton of copper will be

$$\frac{100 \times [10 + (8 \times 1s.\ 9d.)]}{8} = £15.$$

In the latter part of 1859 the miners received £90 per ton of copper in the ore, when the selling price of copper was £112. 10*s.* Hence, in smelting at that time there should have been £7. 10*s.* profit on smelting per ton of copper. But this would not represent the *actual profit* of the

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* Procédés Métall., &c., p. 414.

† Notice sur les Usines à Cuivre et les Usines à Antimoine des Bouches-du-Rhône. Par M. L. Simonin, Ingénieur Civil à Marseilles, p. 535. Bulletin de la Société de l'Industrie Minérale, 3, 4ième Livraison, 1858.

‡ Procédés Métall., &c., p. 414.

smelter, as certain commercial expenses, such as discount, &c., connected with the sale of the metal, would have to be deducted.

According to one smelter the cost of reduction at large works with which he was connected was £1. 3*s*. 11*d*. per ton of ore on the average; and the cost on the ton of copper never exceeded £10, but was often less.

Cost of copper works and capital required.—The cost will obviously vary considerably with the locality and nature of the site; it may be necessary to construct expensive wharves or quays, and in every case a large piece of spare land is required on which to deposit slags, ashes, and other waste. I am informed that works on the *smallest* scale to afford any prospect of success should be capable of making 1,100 tons of fine copper per annum from a good mixture of ores yielding, say on an average, 10 per cent. Such works would contain about 18 furnaces (say 6 calciners and 12 others) with all the necessary accompaniments, and may be estimated at a cost of £9,500 or £10,000. The calciners may be estimated at £240, and the melting furnaces at £200 each, exclusive of workmen's tools, &c., The additional capital needed to carry on the concern in an independent manner should be £35,000, making a total of £45,000. If such works were judiciously constructed with a view to further extension, their capacity might be doubled at an outlay of about 50 per cent. of the original cost.

Fuel is the largest item of expenditure in copper works, and consequently a situation where suitable and cheap coal can be obtained is of great importance. The quantity of coal consumed will vary much with its quality, and in a greater or less degree with the nature of the ores and the economy of management; but it may be generally estimated that in works such as those supposed there would be an annual consumption of about 20,000 tons of coal, or for every ton of copper made from a mixture of ores yielding 10 per cent. of copper, 18 tons of coal.

The cost of smelting will vary materially with the rate of wages, prices of iron, bricks, and other articles which are largely consumed in copper works. It may, however, be estimated that in producing 1,100 tons of fine copper in such works, and from such ores as those above supposed, there will be an expenditure of £9,600, or about £8. 15*s*. per ton of copper produced. This is the cost of smelting only, exclusive of interest on capital, carriage of ores from mines to port, freight from ports to smelting works, cost of carrying copper to market, expenses attending purchase of ore and sale of copper, with other incidental charges, which vary according to circumstances; such as position of works with respect to supply of ore, proximity to markets, &c.

The profit in copper-smelting must depend in great measure on the possession of ample capital and the exercise of sound commercial judgment in the purchase of ores and the sale of copper. A series of advances in the price of copper may treble the ordinary profits of the smelter; and, on the other hand, a series of falls in the price may not only absorb the profits, but occasion loss. The price of copper is liable to oscillations so considerable, and sometimes so unexpected, as to render mercantile operations connected with the metal not a little uncertain.

The mistake is sometimes made of confounding the management of smelting works with the management of the mercantile business connected therewith—departments which are essentially distinct from each other. It is one thing to know how to *make* iron or copper, and it is another thing to know how to *sell* the metals. The possessors of mineral property would do well to bear this in mind. The proprietor of estates containing valuable measures of coal and ironstone, seeing the prosperity of a neighbouring ironmaster, who pays heavily for a lease of both, might be led to conclude that he ought certainly to rival, if not excel, this neighbour in prosperity by smelting his own ores with his own fuel; and he may make the experiment, and discover that he has been egregiously mistaken in his calculation. He may have succeeded in the metallurgical, but have signally failed in the mercantile part of the business.

Turning over capital.—Capital cannot be turned over in copper smelting more than 2½ times a year when trade is *good*, and 2¼ times is a fair average. It is questionable whether any concern, on an average of ten years, makes 13 per cent. on capital, inclusive of interest at 5 per cent. per annum. In exemplification of the fluctuating state of the copper trade, I may introduce the following facts, which I have received on authority: namely, during two years, about 1839, one of the largest and best-conducted firms in Swansea did not realize more than 5 per cent. per annum; and in 1860, another of the principal firms in Swansea actually lost money.

GEOLOGICAL SOCIETY OF LONDON.

At the meeting of January 8th, Sir C. Lyell, F.G.S., in the chair, Charles Sturtivant Wood, Esq., Geological Survey of Otago, New Zealand; Robert Harris Valpy, Esq., Enborne, Hants; and W. S. Horton, Esq., 10, Church Street, Liverpool, were elected Fellows.

The following communications were read:—

1. "On the Carboniferous Limestone of Oreton and Farlow, Clee Hills, Shropshire." By Professor John Morris, V.P.G.S., and George E. Roberts, Esq. With a Note upon a new species of *Pterichthys*; by Sir P. de M. G. Egerton, Bart., M.P., F.G.S.

The rocks described in this paper are a series of thin beds of limestone and sandstone lying between the Old Red Sandstone of South Shropshire and the Millstone Grit which forms the basement of the Titterstone Clee Coal-field.

In consequence of the opening of new quarries and the cutting of a roadway through the Farlow Ridge transversely to the strike of these deposits, the authors were enabled to add somewhat to the description of the locality given in "The Silurian System." The series of deposits from the Old Red "cornstone," upwards, was shown by them to be:—1. Laminated yellow sandstones, with pebble-beds and sands. 2. Bright-yellow sandstones containing *Pterichthys*. 3. Brecciated yellow sandstones, pebble-beds, sandy layers, and laminated sandstones. 4. Sandy and concretionary limestone. 5. Grey oolitic limestones, containing palatal teeth of great size. 6. Clays, with ferruginous bands. 7. Shaly crinoidal limestones. 8. Clays with limestone-concretions, and shaly limestones. Against the last-mentioned bed, the Millstone Grit rests unconformably.

These beds thicken out at Oreton, a mile east of this Farlow section, and are there extensively worked for various economic purposes, the oolitic limestones, locally termed "jumbles," being used for decorative purposes under the name of "Clee Hill marble." In describing the physical conditions of the localities, mention was made of the "mole river," which losing itself at the west end of the ridge, takes a subterranean course nearly parallel with its axis, and reappears at its lower end, a mile distant. An interesting fact was communicated to the authors by the Rev. J. Williams, of Farlow, of an accidental accumulation in the hollow of its inlet, of a body of water estimated at 1,635,000 cubic feet, the whole of which was carried away in 48 hours by the sudden clearance of the channel.

In describing the palæontology of these rocks, the authors specially drew attention to the fortunate discovery of the Yellow Sandstone of Farlow, of *Pterichthys macrocephalus* (spec. nov., Egerton), made while reducing the thickness of a large ripple-marked slab sent them by Mr. Weaver Jones in illustration of the physical conditions of the deposit. This *Pterichthys* proving identical with the fragment previously found in the Farlow sandstone by Thomas Baxter, Esq., F.G.S., they attached to the paper a descriptive note on that fossil, by Sir Philip Egerton, in which the Farlow *Pterichthys* was contrasted with that of Dura Den, and additional proof given of the identity of the genera *Pamphractus* and *Pterichthys*. In addi-

tion to Pterichthyoid remains, scales of two species of *Holoptychius*, one probably new, had been found by them.

The richness of the overlying limestones in palatal teeth was shown by a fine series of examples, amongst which *Orodus ramosus*, of unusual size and in perfect condition, and an undescribed *Pœcilodus*, of great magnitude, were most conspicuous. Other genera represented were *Helodus*, *Psammodus*, *Cladodus*, *Cochliodus*, *Petalodus*, and *Ctenoptychius*. Ichthyodorulites, of large size and rich ornament, chiefly belonging to the genera *Ctenacanthus* and *Oracanthus*, accompany these teeth.

The notices of the invertebrate fauna given by the authors proved the assumed lowness of the Oreton limestones in the Mountain-limestone series,—the zone of *Rhynchonella pleurodon* being well marked, Crinoidal and Bryozoan remain abundant through fragmentary, and Corals nearly absent.

A large series of *Pterichthyes* and of rock-specimens were exhibited in illustration by Mr. George E. Roberts; and a collection of palatal teeth was liberally sent for exhibition by W. Weaver Jones, Esq., of Cleobury Mortimer, and by Edward Baugh, Esq., of Bewdley.

2. "On some Fossil Plants, showing Structure, from the Lower Coal-measures of Lancashire." By E. W. Binney, Esq., F.R.S., F.G.S.

After noticing the views taken of the structure of *Lepidodendron* by Hooker and others, the author proceeded to describe three portions of calcified stems lepidodendroid in external appearance, two of which exhibit in section a central axis composed not of cellular tissue but of large, transversely barred, hexagonal vessels. These two specimens the author refers to a new species, *Sigillaria vascularis*. The third specimen differs from the others in the absence of the thin radiating cylinder of barred vessels around the central axis; this he terms *Lepidodendron vasculare*.

Microscopical preparations and photographs of sections were supplied by the author.

3. "Supplemental Notes on the Plant-beds of Central India." By the Rev. S. Hislop. In a Letter to the Assistant-Secretary.

Mr. Hislop, in noticing the discovery of more remains of Plants, Insects, and Fishes at Kota on the Pranhita, stated that he certainly now thought that the ichthyolitic beds of Kota (probably lower-jurassic in age) are higher in relative position than the plant-sandstone of Nagpur, which, with the Sironcha sandstone underlying the Kota Limestone, belong to the Damuda Group, He remarked also that, in his opinion, the *Tæniopteris* of Kampti would prove that the Damuda and Rajmahal groups cannot be widely separated.

The last meeting of the Society was held (at Burlington House) on January 22nd, when the following papers were read:—

1. "On the further discovery of Flint Implements in Gravel near Bedford." By James Wyatt, Esq., F.G.S.

2. "On the Hyæna-den at Wookey Hole near Wells." By W. Boyd Dawkins, Esq., F.G.S.

3. "On the Drift containing Arctic Shells and other Fossil Remains, in the neighbourhood of Wolverhampton." By the Rev. W. Lister, F.G.S.

THE MINES OF RIO TINTO.

Notes on the Mines of Rio Tinto, Province of Huelva, Spain. By Joseph Lee Thomas, Assoc. Inst. C.E. London: Warren Hall and Co., 42, Cornhill.

In this pamphlet of 32 pages, Mr. Thomas has succeeded in giving a most valuable description of the mines of the province of Huelva lying in the neighbourhood of Rio Tinto, and of the metallurgical processes by which the

ores are treated, and their commercial results. The pamphlet is evidently a business statement, probably prepared with immediate reference to commercial purposes, and consequently should scarcely be regarded or criticised as a scientific paper; but we can safely say that it is a clear, and we believe perfectly sound and accurate description of the important mines in question —clearer and sounder than others of infinitely greater pretensions—and one which will be read with very general interest.

The remarkable mineral deposits in the neighbourhood of Rio Tinto are only paralleled in these islands by the great pyrites deposits on either side of the Ovoca valley, in the county of Wicklow. They are both essentially deposits of iron pyrites, containing a small per centage of copper pyrites, which occur in great masses, often lenticular in form, and having the same direction and dip as the strike and inclination of the rocks they traverse. As in the case of the Wicklow Mines, the Rio Tinto deposits are also accompanied by a zone of porphyritic rock often forming the wall of the deposits. In both cases the pyrites deposits are likewise often covered by a surface formation of oxide of iron; indeed, on the whole, their points of similitude seem to be very striking, except that the Spanish deposits are on a very much larger scale.

The following extracts from Mr. Thomas's pamphlet will put the reader in possession of some of the more prominent facts of this remarkable district:—

"The mines of Rio Tinto are situate in the north-west of the province of Huelva, about twelve leagues to the west of the city of Seville, and eleven to the north-east of the town of Huelva, the capital and shipping port of the province whose name it bears.

"The mine of Rio Tinto does not stand alone in the province, but is one of many which the ancients have worked in a zone of metalliferous rock, which may be described as having Castillo de las Guardias for its most western, and Grandola in Portugal for its most eastern limit. In Portugal, and near to the river Guadiana, the mine of San Domingo is being very profitably worked by English adventurers.

"The mining district under consideration extends thirty-six leagues from east to west. The formation is the clayslate, destitute as far as is yet known of fossils. The strike of the slates is from east to west, and the dip (except where disturbed by eruptive rocks) north—the angle varying but little from the vertical. Within the limits we have indicated the slates are traversed by porphyritic eruptions, and it is near the line of contact of the schist and porphyry that the deposits of ore generally occur. These masses of mineral are usually lenticular in form, and have the same direction as the strike of the rocks they traverse. They are found sometimes entirely imbedded in the porphyry, at others entirely in the schist, but most often I think with the porphyry forming the northern wall, and the slates the southern one of the deposit. The want of characteristic fossils prevents one classifying the slates with certainty, but they most likely belong to the lower silurian formation. The ore is essentially iron pyrites, but is accompanied by a small per centage of copper pyrites and some silex, say one to two per cent.; galena and blende are also found in small quantities disseminated through the mass. In the process of calcination the ore gives off large quantities of arsenious acid, the arsenic very probably being present as arsenical pyrites.

"Alternating with the deposits of iron pyrites are others of manganese. The outcrop of these latter is very marked, and it is curious that they should so long have escaped attention. Numerous mines of manganese (pyrolusite) are however now being worked, and large quantities of very pure ore, assaying sixty-three per cent., raised and exported to England. Its price, delivered at Huelva, is 12 reals per quintal, or £2. 15*s*. per ton.

"The mines of the province of Huelva are supposed to have been worked by the Phœnicians, Carthaginians, and Romans. That the Romans worked

them there is abundant proof: that the Phœnicians and Carthaginians did is a mere hypothesis."

"The mines of Rio Tinto have been worked more or less by the Spaniards and foreigners since 1727, but it is only since 1783, in which year the government took them into their own hands, that they have assumed any importance. From A.D. 1783 to1810, the copper made was 287,649 ars. or 3,269 tons; its cost to the state was 41,192,081 R. Von, or £429,084. 3*s.*, equal to £131. 5*s.* per ton. From A.D. 1810 until 1825, owing to the disturbed political state of Spain, the mine was almost abandoned, and the quantity of copper produced was insignificant. On the 6th of December, 1827, the government issued a real order ordaining the leasing of the mines for twenty years to any foreigner or Spaniard, subject to certain conditions. On the 24th of April, 1829, they were handed over to Gaspar Remisa, on conditions that he should pay an annual rent, for the first ten years of the twenty for which they were leased, of 260,000 R. Von, or £2,708 sterling; and, for the second ten years, of 310,000 R. Von, or £3,229. Of the 150 houses which then comprised the village of Rio Tinto, 136 were placed at the disposition of Remisa, as also were the pine forests comprised within the limits of the sett, and valued at £15,000.

"Remisa's lease expired in 1849, and since that time the government have worked the mine—which he appears to have left in a ruinous condition—on their own account. From A.D. 1849 to 1858 inclusive, the copper made appears to have been 525,095 ars. or 5,967 tons, equal to an average annual production of 597 tons nearly. The ore extracted during the same period is given at 27,919,008 ars. or 317,261 tons, which, compared with the produce of copper stated above, would give 1·88 per cent. as the actual yield of the ore. This is, however, higher than the result really obtained, inasmuch as in the 5,967 tons is included the copper produced by the cementation of the water issuing from the mine, which has of late years yielded 16,000 ars. of precipitate, or more than 100 tons of fine copper annually. Taking this into consideration, 1·50 per cent. would be approximately the yield of the ore during the period in question.

"In March, 1849, the government entered into a contract with a private company entitled Los Planes, by which they bound themselves to supply monthly to the company 25,000 quintals or 1,136 tons of ore for fifteen years, receiving in payment all the copper obtained, the minimum accepted being 1¼ per cent. of the ore delivered. They also agreed to pay the company of Los Planes 56 reals per aroba, or £50. 2*s.* per ton for the refined copper returned to them.

"To another company called La Cerda, the government contracted to supply half the surplus ore remaining in their hands after completing the above contract, subject to the same conditions as in the case of Los Planes, with the exception that in the latter instance the amount paid by the state to the company for the manufacture of the copper was stipulated at 50 reals per aroba, or £45. 17*s.* per ton.

"The copper manufactured by the above companies is included in the 5,967 tons given as the produce of the mines from 1849 to 1858 inclusive. The largest per centage obtained in any one year by the Fabrica de los Planes was 1.75 per cent. of the ore delivered to them; but of late years the yield they have obtained from the ores has but slightly exceeded the 1¼ per cent. stipulated for by the government. This apparent falling off in the per centage of copper obtained from the ore delivered to the Fabrica de los Planes is traceable to two causes. The first, and perhaps the one which most conduces to this result is, that the government engineers have of late years taken more care to obtain from the waters issuing from the mine the copper contained in them, instead of allowing the Los Planes company to benefit by their negligence in this particular. They have also, I am told, exercised a stricter surveillance over the distribution of the ore to the various cementing

floors, and have not allowed the company in question to select the richer mineral.

"Within the boundaries of the sett there are three lodes, which traverse it from east to west. The northern and central ones are apparently divided, for the greater part of their length, by a wedge of porphyry, but meet at their eastern extremities; they may be regarded as forming one deposit divided for a part of its length by a wedge of sterile ground. Their length would seem from surface indications to be about 2,500 metres.

"The southern lode or deposit is to all appearances of greater length than the northern and central ones, and is separated from them by a larger wedge of country than they from one another. It is to this deposit that the workings of the Spaniards have been confined. The lode has been opened up by them for a length of 500 metres, and its average width for that distance has been 71 metres nearly. The levels driving east and west are both in ore.

"The mass of ore does not make to the surface, but is covered with a deposit of oxide of iron, more or less mixed with decomposed porphyry, and varying in thickness in different localities; for the length of 500 metres, for which the mine is worked, the thickness of this deposit is about 25 metres.

"The line of junction between the covering and the mineral is regular and unbroken, and looks more like the work of human hands than a natural formation. At the Lagunazo Mine, where works have lately been commenced by an English company, ore has been cut at a depth of seven metres only from the surface: this I am inclined to believe is no special instance.

"The outline and extent of the deposits of ore contained within the Rio Tinto sett are not sufficiently well known to admit of any estimate of returns being submitted, based entirely on such information. That possessed is, however, ample to warrant the inference that the quantity of ore it is possible to extract within a fixed period will be limited rather by external circumstances than by the capabilities of the mine itself.

"The mineral extracted from the present limited field in 1858 and 1859 respectively was:—

			PER MONTH.
	Quintals.	Tons.	Tons.
In 1858	982,647	44,665	3,722
,, 1859	1,330,140	60,460	5,038

During the latter year the present manager, Dr. Ramon Figueroa, has, I am told, done all in his power to increase the returns, and that the great difficulty he has had to deal with has been the deficiency of skilled mining labour.

"From Dn. Juan Aldana, formerly government engineer and director to the mines of Rio Tinto, I learned that the average cost of raising a quintal of ore there was 1 rl. 15 c., and per ton of 22 quintals, 25 rls. 50 c., or 5*s*. 3¼*d*. For 1859, the cost was given me as 1 rl. 8 c. per quintal, equal to 23 rls. 76 c. or 4*s*. 11¼*d*. per ton, divided as under:—

Breaking, 69 rls. 24 c. per cubic metre -	66c. per quintal.
Wheeling - - - - -	20c. ,,
Hauling - - - - -	22c. ,,
	1 real 8c, per quintal.

The above cost does not, I believe, include the maintenance of the hauling machinery and superintendence.

"At El Tharsis the cost was stated at 24 rls. or 5*s*. per ton.

"At the Chaparita Mine, where the lode is of less width, the cost of breaking and raising to surface was stated at 1 rl. 21 c. per quintal, or 26 rls. 62 c., equal to 5*s*. 6½*d*. per ton.

"The mean of the above is 5*s*. 2¼*d*. per ton."

The next, and most important, portion of Mr. Thomas's pamphlet relates to the metallurgical modes of treating the ores—particularly in their commercial bearing.

The mean assay of the quantity of copper contained in the Rio Tinto ores does not seem to be a settled question, but Mr. Thomas considers the nearest estimate to be about 3½ per cent. The various processes by which the copper is at present extracted, and the cost of each by the cementation process, is thus described.

"The ore first undergoes a calcination, the object of which is to convert the insoluble sulphuret into a soluble sulphate; after this is effected, it is put into tanks which are then charged with water. The water, when it is drawn off into other tanks, contains salts of iron and copper in solution; the latter is then precipitated with pig iron. The resulting precipitate is made into balls, which are calcined, and afterwards reduced to black copper in a German blast hearth, and refined in a reverbatory furnace. The refined metal is not ladled direct from the furnace, but is run into an exterior basin placed at the back, from which it is ladled into moulds. The slags of these two operations are reduced in a Castilian furnace.

"The calcination is effected in heaps, varying in dimensions; a common measurement for the base of the truncated pyramid is 12 metres by 7 metres; the usual height is about 1 metre: such a heap contains about 4,000 quintals of ore, and requires to light it 200 cargas of barda,* at 2½ reals per carga, and 25 cargas of cepas (roots), at from 3 to 4 reals per carga.† The cost of calcination at the Rio Tinto mines, labour and fuel included, was, in 1859, 36 cents per quintal of ore, equal to 1*s.* 7¾*d.* per ton. The time required to complete the operation is from five to six months.

"The heaps are open to the air and have no covering of any sort. The prevalence of wind and rain consequently exercises a considerable influence over the calcination. During five months of the year heavy rains are common in Spain, and a great proportion of the sulphate of copper must be washed away as soon as formed. The exposure to strong currents of air gives rise to the fusion of a considerable proportion of the sulphurets and the decomposition of the sulphates which pass into oxides and insoluble salts. To the above causes is in no small degree attributable the small yield of copper obtained from the ore in the after process of lixiviation.

"The calcined mineral is carried on the backs of mules or donkeys to the lixiviation tanks. These are generally constructed of rough masonry, and lined with asphalt; their dimensions vary considerably, but the most common size is 7 metres long by 4½ wide and 1 deep. They are two-thirds filled with ore, and contain about 2,000 arobas, say 23 tons nearly. The length of time the ore is allowed to remain in the tanks varies in different establishments; it depends on the quality of the ore, and the greater or less perfection of the calcination. At Rio Tinto from seven to nine days are usually considered sufficient. In the establishment of La Chaparita it is often as long as twelve days. The waters are drawn off and renewed as often as is considered necessary. The first water is saturated in two or three hours, and the last is left as many days.

"From the lixiviation tanks the water charged with salts of iron and copper pass to those of cementation; the latter being of nearly the same form and dimensions as the former. In them are placed piles of pig iron forming squares.

"During the winter months it is found necessary to agitate the water to accelerate the precipitation of the copper, but during the prevalence of the hot weather this is not much practised.

"When the solution has been sufficiently impoverished, it is drawn off into a third tank, and left to deposit the subsalts of iron held in suspension: the

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* The local term for the brushwood of the district.

† The carga varies from 5 to 6 arobas in weight.

resulting precipitate is found to contain 10 per cent. of copper and a good deal of arsenic.

"After the solution has been drawn off from the cementation tanks, men are put to clean the pigs of iron of the scales of copper adhering to them and to collect the precipitate. This assays about 55 per cent. for copper, and varies from 50 to 60 per cent.

"The iron consumed in cementing at the Rio Tinto mines for the year 1859 was 2.17 to 1 of copper.

"The precipitate is collected in heaps and made into balls of about 5 inches diameter, and calcined in furnaces.

"The quintal of calcined mineral costs for expenses of lixiviation and cementation 1 real 72 c. or 4¾*d.* nearly.

"The precipitate is reduced to black copper in a German blast hearth, capable of treating in twenty-four hours about 176 arobas, or 2 tons. The fuel consumed (charcoal) varies from 30 to 34 per cent. of the weight of the precipitate smelted. The charge consists of 28 arobas of precipitate, and the number of charges treated in the twenty-four hours depends on its greater or less purity.

"The cost at Rio Tinto for 1859 was given me as 1 real 13 c. per quintal of precipitate. At La Chaparita, where the marcilla of charcoal costs only 2½ reals, the cost is stated to be 1 real 25 c. per quintal.

"The refining furnace will treat 220 arobas of black copper in twenty-four hours. The fuel consumed is about 220 arobas of pine wood, and the yield of fine copper from 84 to 90 per cent. of the black copper charged. The cost of refining at Rio Tinto for the year 1859 was 2 reals 68 c. per aroba of fine copper produced, and at La Chaparita 2 reals 35 c."

"The rich slags from the German hearth and refining furnace are reduced in a Castilian furnace. In twenty-four hours the matter charged usually consists of

90	arobas of rich slags,	assaying 18 per cent.
120	" flux	poor slags.
210	arobas.	

The cost is as under:—

Fuel—50 marcillas, equal to 58 arobas of charcoal, at 3 reals	150
Labour	88
R. Von.	238

The black copper yielded by the above quantity of rich slags would be 20 arobas, and the cost per aroba 11 reals 90 c. At Rio Tinto the actual cost for the year 1859, of black copper assaying 85 per cent., was 12 reals 50 c. per aroba. At the Chaparita establishment the cost was 11 reals per aroba."

The question of the total cost of producing copper at Rio Tinto is next discussed, affording the following results:—

"Dn. Ramon Figueroa, the director of the Rio Tinto mines, assured me that, for the year 1859, the total cost of the black copper produced, for mining, cementation and smelting charges, was 53 reals 96 c., and that it yielded 84.89 per cent. of fine copper. Assuming this, the cost of an aroba of copper will be—

	Reals.	cents.
For black copper	63	56
Refining charges	2	68
R. Von.	66	24

Supposing the ore to yield 1½ per cent., to compare the above result with the contract price paid to the company of Los Planes, we must deduct from it

the mining charges on 16·66 quintals of ore, the quantity required to produce 1 aroba of fine copper.

		Reals.	cents.
Cost of fine copper as above...		66	24
Less mining charges on 16·66 quintals of ore, at 1 real 8 c.		17	99
Cost to the government of cementing and smelting	R. Von.	48	25

"The company of Los Planes receive 56 reals per aroba, and the cost to the government is 48 reals 25 c. The profit, then, of the former may be estimated at 7 reals 75 c. per aroba."

Upon this basis of calculation, Mr. Thomas estimates that the profits of the Spanish government should realize on the present annual production of 60,460 tons, at £25,026. 13*s*.

Mr. Thomas at this point makes a short digression for the purpose of comparing the results obtained by the Rio Tinto system, and those arrived at at Agordo, in the Venetian States, an establishment worked by the Austrian government, where cupriferous pyrites, containing little more than 1½ per cent. of copper—not half the produce of that of Rio Tinto—is successfully treated. This process is elaborately described in Dr. Percy's "Metallurgy," pages 439-447, to which we refer our readers for a detailed and scientific description. The essential point is what is called "kernel-roasting," which is at present performed in "styrian kilns," which are found to answer decidedly better than the old method of roasting in piles or open heaps. Drawings of the kilns, and full details as to the mode of charging them, are given by Dr. Percy. As to the latter, the principal point seems to be to arrange the charge in alternate layers of *large* and *small* ore, and to place at intervals some beds of chips. The roasting occupies five or six months—about 288 tonnes being treated at a time. After this roasting process is completed, the charge is removed and the lumps of ore broken, when they are found to contain a "kernel" of enriched copper regulus enclosed in earthy shells of oxide of iron. The theory of the mode in which this concentration is effected is not very clear. Of the explanations which have been offered by continental chemists, Dr. Percy remarks: "these, as far as I can understand them, appear to amount to little more than a detail of certain reactions, which while they tend to explain the formation of regulus of copper, yet fail to render a rational account of the cause of the actual transference of the metal from every part of a lump of ore and its concentration in a small space in the centre. The phenomenon has been regarded as somewhat, if not strictly, analogous to what takes place in the formation of steel by the cementation process. ......But this process of cementation is still very obscure, and as much needs explanation as that of kernel-roasting itself."

In the Agordo process the total loss amounts to less than 10 per cent. of the copper contained in ores yielding originally but little more than 1½ per cent. In the Rio Tinto process, the loss is upwards of 50 per cent.—ores containing 3½ per cent. of copper not turning out more than 1½. As to the possibility of introducing the former process into the Spanish mines, Mr. Thomas remarks:—

"Under existing circumstances the dearness and scarcity of fuel at Rio Tinto renders difficult the entire adoption there of the routine of cementation practised at Agordo; but in any case the existing method might be advantageously modified. I am by no means certain that a sufficient supply of brushwood could not be obtained at Rio Tinto to effect the reduction of the rich ore, matt, and precipitate in suitably constructed reverbatory furnaces; and if so, the Agordo system could be adopted in its entirety.

"In Spain the duty on copper is 3 per cent., but in addition to this the mines of the Huelva district pay the government an enormous duty on the

pig iron consumed in precipitating it. In levying this the State does not even consult its own interests, leaving out of the question those of the industry of the country. Were the duty on the pig iron used in cementation removed, a second calcination would soon become universal among the establishments of the province of Huelva, but at present the larger per centage of salts of iron contained in the solution obtained from the ore that has undergone a second calcination and consequent increased consumption of pig iron in precipitating the copper, deters the various companies from practising it. This objectionable tax removed, the mines would make more copper from the same quantity of ore, and the government realize the 3 per cent. duty on the greater quantity."

Mr. Thomas now turns to a consideration of the results that would attend the working of the Rio Tinto Mines, when connected by railway with Huelva. This he considers under three heads, the profits of the railway being estimated under any circumstances at at least 17 per cent.

"1st.—The financial result that would attend the exportation of the whole of the ore raised.

2nd.—Do., the smelting at the Rio Tinto mines of the whole of the ore raised.

3rd.—Do. do. at Huelva."

All based upon a raising of 120,000 of ore per annum; that is, double the present returns—an amount that could undoubtedly be easily reached.

Under the 1st head, exportation of the whole of the ore, he arrives at an estimated profit of £161,917 per annum; *assuming that the increased supply of ores in England would not materially affect the market value.*

Under the 2nd head, the reducing of the ores at Rio Tinto, by means of fuel carried up by the railway, he arrives at an estimated profit of £92,125 per annum. He recommends the use of a blast-furnace instead of a reverbatory one, as the more economical.

Under the 3rd head, the reduction of the ore at Huelva, he arrives at a profit of £41,275, exclusive of any value to be derived from the sulphur. As to the prospect of being able to make this available in Spain, Mr. Thomas remarks :—

"The object of calcining and reducing the ore to a matt at Huelva would of course be the application of the sulphur, entirely lost at Rio Tinto, to the manufacture of sulphuric acid and sulphate of soda.

"In England the ore is worth for the sulphur it contains £1. 10*s*. per ton, and the 120,000 tons we have supposed to be raised may therefore be valued at £180,000 for sulphur. At Huelva the value to be put upon it would be very much less than this, and would in a great measure be dependent on the fiscal arrangements of the government.

"In Spain salt is a government monopoly. The salt works are in the hands of private individuals, who are compelled to sell to the State all they make at 2½ reals per quintal, or 11*s*. 6*d* per ton; the latter retailing it to the public at 40 reals per quintal, or £9. 3*s*. 4*d*. per ton. Previous, then, to undertaking the manufacture of sulphate of soda, the government permission to establish "Salinas," and to make such salt as may be required, must be obtained. Were this granted, no difficulty would be encountered in selecting a suitable spot for works in the vicinity of Huelva, and I am of opinion that the manufacture of the products in question could be economically carried out there."

Such is the position of the mines of Rio Tinto, as described by Mr. Thomas. That a district of almost unbounded mineral wealth exists in this part of Spain is beyond all doubt; and it is equally clear, as Mr. Thomas says, that its present condition is, in this age of science and railways, a disgrace to the country that possesses it. But Spain is a country progressing in material resources at the present day faster than any other in Europe; and in a few years we may expect to see great changes.

THE *ANNALES DES MINES* ON THE PRESENT POSITION OF THE METALLURGY OF IRON IN ENGLAND.

Annales des Mines, ou Recueil de Mémoires sur l'Explortation des Mines, et sur les Sciences et les Arts qui s'y rapportent. Rédigées par les Ingéneurs des Mines, et publiées sous l'Autorisation du Ministre des Travaux Publics. Cinquième Serie. Tome XIX. 1861. Paris: Dunod, Quai des Augustins.

This famous periodical, by far the most renowned publication in the world connected with mining and metallurgy, has long been particularly celebrated for the descriptions which, from time to time, have appeared in its pages on the mines, mining appliances and machinery, and metallurgical processes of other countries. To a great degree this may be accounted for by the natural dearth of subjects available in a country so comparatively poor in mineral resources as France, particularly when compared with the supply of highly cultivated ability afforded by such a corps as the French *Ingêneurs des Mines*—a corps selected by competition from the choicest youth of France. But, to whatever cause it may be attributable, to the *Annales des Mines* is due the credit of being generally foremost in describing the mining and metallurgical processes in use in every part of Europe, being even not unfrequently beforehand with local engineers. In this country they have certainly managed to go ahead of Englishmen in describing many of our most important operations. Le Play was the first to give any complete description of our modes of copper-smelting, Combes was one of the earliest to teach Europe and our own engineers what extraordinary machines we possessed in the Cornish condensing engines, the details of whose duty had been previously laughed to scorn. Even in our own time, M. Moissenet has given by far the best, and indeed the only complete, description of the Cornish methods of tin dressing—a point of the greatest value at the present moment. The same author has also anticipated, by the few months, Dr. Percy's description of the Cornish methods of assaying in all essential particulars. We believe that at the present moment French engineers are examining the salt deposits of Cheshire; and to them we will also be probably indebted for the first comprehensive description of these little known but highly important sources of our national industry.

Consequently, in a periodical so celebrated for dealing successfully with the mining and metallurgical progress of other countries than its own, we naturally look with considerable interest on an elaborate paper contributed to it, by two eminent engineers especially commissioned by the French Minister of Public Works, on the present position of that great branch of industry upon which so much of our material prosperity and wealth depends.

The authors of the paper in question are Monsieur Gruner, Professor of Metallurgy at the Imperial School of Mines, Paris, and Monsieur Lan, occupying a similar position at the Mining School of Saint-Etienne. To enter into anything like a complete analysis of their elaborate memoir, which extends over two *livraisons* of the *Annales*, would exceed the space at our disposal; so, on the present occasion, we shall content ourselves by referring to a few topics of general interest, reserving a general analysis of the paper for another occasion. Coal, both in regard to cost and general fitness, being the basis of all iron industry, the paper commences with enquiries respecting that mineral.

Comparative Rents and Royalties payable on Coal in England and France.—In England the property in minerals belongs to the proprietors of the soil.* These they usually let or farm at certain royalties fixed at their

* We suppose that most of our readers are aware that in France, and generally on the continent, this is not the case. All mines are under the control of the State, which alone has the right of dealing with them, and fixes the royalties payable to itself and the owners of the soil—never exceeding 5 per cent on the net profits.

pleasure. These royalties, small originally, have gone on progressively increasing, and form at present one of the heaviest charges, particularly having regard to the prices of the coal. In the western part of the Dudley district, for instance, where competition is so keen, the royalties paid reach, in certain instances, to 2*s*. and 3*s*. per ton. The mean royalty paid in the Newcastle district is only about 6*d*. per ton; but, taking the whole of the great coal districts of England, we may assume a general average of from 6*d*. to 9*d*. per ton—or about 12 per cent. on the average selling price of say 5*s*. These are very much greater dues than are paid in France, where the royalty paid to the State has not, on an average, exceeded a limit of from 1*d*. to $1\frac{3}{4}$*d*. per ton. In some parts of France certainly these payments are as unequal as they are in England; and if in some parts of South Staffordshire 2*s*. or 3*s*. per ton is paid, the mines of Saint-Etienne paid, in 1858, about 8*d*. per ton to the proprietors of the soil, and $2\frac{3}{4}$*d*. per ton to the State, and some of the collieries of the department of *la Loire* as much as 5*d*. or 6*d*. to the State, and 9*d*. and 1*s*. to the proprietors of the soil—although, in considering this, it must be borne in mind that the selling price is precisely double in France.

But the measure of the greater burden borne by English colliery workers is not merely shown by the above figures, for experience shows that in England the royalties go on continually increasing, while in the department of *la Loire*, the heaviest burdened in France, they decrease with the depth to a certain limit. And besides the French *concessionnaires* are not merely tenants on a terminable lease, but absolute proprietors, subject to terms fixed by general laws, as long as they choose to continue the works. The system of terminable leases also leads to a grasping spirit of working and a consequent waste, a system which evidently leads to a discount of the Future to the profit of the Present: thus in Staffordshire half the coal has been sacrificed, and at least a quarter is still lost there as well as in Scotland.

On the other hand, if the mines of England are burdened with heavier rents than those of France, they are free from the troublesome interference of the State, and the endless formalities which are required by the French mineral laws, which can only be thoroughly appreciated by those who have been subject to them. As the authors of this memoir justly say:—"*Il est vrai que si l'Etat ne fait rien, au moins il ne gêne pas les travaux des compagnies, comme trop souvent cela arrive en France.*" The existence of large properties, too, facilitates the construction of the local railways, which in France are impracticable without the intervention of the State.

Comparative price and increasing production and consumption of Coal in England and France.—The great advantage which the iron industry of England possesses over that of France is the low price of coal, averaging about 5*s*. per ton, while in France it averages exactly double, or 10*s*. per ton. But the real difference is even still greater than is shown by these figures, for the English price applies to *large* or *screened* coal, while the French price applies to the average of the whole. The difference was not so great twenty-five or thirty years ago, or even eight or ten years ago; and everything tends to show that the difference of price in the two countries has now reached a maximum which may be expected to decrease.

The coal-fields of France, with the exception of those of the departments of the *Nord* and *la Vendée*, being situated in the centre of the country, were until recently inaccessible to distant consumers. Thanks to railways and canals this is now modified; but still the disadvantages of France must in this respect always be considerable. Yet, within the last twenty years the French colliery industry has developed itself comparatively more rapidly than in England: in that country the production and consumption have both trebled since 1830, while in France, within the same period, the

production has increased in the ratio of 1 to 4½, and the consumption in that of 1 to 5½. From 1831 to 1833 the total quantity of combustible mineral furnished annually only reached a mean of from 1,500,000 tons to 1,600,000 tons, and the consumption to 2,500,000 tons; while in 1859 the production of France had augmented to 7,500,000 tons, and the consumption to 13,500,000 tons. This result is encouraging; and if the French production has not kept pace with the consumption, it may be expected that the completion of canals, lines of railways, with the reduction of duties and tolls, will contribute more than any thing else to make up the deficiency.

On the nature of the various Coals.—This is a very valuable portion of the memoir, particularly as it gives the result of the experiments made at the French dock-yards on the various qualities of English and French coals. We may refer to this on another occasion.

The fifth chapter of the memoir brings us to the IRON ORES, and the consideration of the comparative cost and capabilities of those of England and France. The description of the English iron ores, their localities and modes of occurrence, statistics, and comparative capabilities, is very complete, but naturally presents no particular feature not before known to those acquainted with the subject. The authors class these ores into the five following divisions:—

1. Ores of the coal measures, including the argillaceous iron-stone and the black-band.
2. The red hæmatites (red ores) of Lancashire and Cumberland, worked in the carboniferous limestone.
3. The oolitic ores of Cleveland, and those of the secondary strata of Northampton, Buckingham, Oxford, &c.
4. The brown hæmatites and spathic ores found scattered in Cornwall, Devonshire, Somersetshire, and parts of Wales, Cumberland and Northumberland, generally in comparatively small quantities.
5. The ore found at Froghall, in North Staffordshire, in the millstone-grit, and which is found to pass, at points, into the ordinary clay iron-stones, and even black-bands.

Comparative price of English and French iron ores.—In this respect England is at as decided a disadvantage as France is in the case of coals. France is richer in iron ores than England, the greater part of the large iron-works of the former country incurring a much less cost per ton for the ores necessary to produce a ton of pig-iron than makers in the latter country. The authors here take exception to the figures given in Mr. Hunt's "Mineral Statistics" for 1858, as to the cost of iron ores, particularly those of the coal-measures: "*Nous croyons qu'il y a positivement erreur dans les chiffres officiels, ou que les prix mentionnés ne comprennent pas la redevance payée au propriétaire du sol.*" Passing over this point we shall conclude this abstract with the following observations of the authors on the comparative cost of the ores to the English and French iron makers:—

"If therefore in England, in one special district, as that of Cleveland, the cost of the ore per ton of pig-iron does not exceed from 14*s.* 6*d.* to 16*s.* 6*d.*, there are also works in France specially favoured, like those of *la Moselle*, where the cost of the ore per ton of pig-iron does not exceed 12*s.* 6*d.* But leaving out of the question this special case, it is undoubted that in England there is in general consumed, per ton of pig-iron, ores to the value of from 29*s.* to 33*s.* 6*d.*; while in France the value does not exceed from 21*s.* to 25*s.*; thus showing an advantage to the latter country, in the matter of ores, of about 8*s.* per ton of pig-iron, and from 2*s.* 6*d.* to 3*s.* 3*d.* per ton of ore.

"It is clear that the great advantage of the English maker is really in the low price of coal, and that in the matter of ores the advantage rests with France. In this respect France is in about the same position as Belgium; but like the English the Belgians have the advantage of cheaper coal."

THE BLOW-PIPE VADE-MECUM.

The Blow-pipe Characters of Minerals. Deduced from the original observations of AQUILLA SMITH, M.D., M.R.I.A., Vice-President of the King and Queen's College of Physicians. Alphabetically arranged and edited by the Rev. SAMUEL HAUGHTON, M.A., F.R.S., President of the Geological Society of Dublin; and ROBERT H. SCOTT, M.A., Secretary of the Geological Society of Dublin. London: Williams and Norgate.

WITHIN the last few years several publications have appeared in this country on the blow-pipe, mostly either translations of German works, or at least principally derived from German sources. One of the most useful of these has been published by Messrs. Williams and Norgate—that of Mr. Blanford, founded on Scheerer.

The present work, however, occupies a different position from any of these, for it is *original.* This originality is in some cases not without its drawbacks, for it deprives us of the advantages derived from previous investigations; still, on the whole, it gives a value to the work which no mere compilation can possess, and undoubtedly renders it, as the editors say, "a most valuable addition to British Blow-pipe Literature."

The instructions for the use of the instrument, and the various supports and re-agents, are simple, and seem in all cases to be derived from original observations. Some of these are rather old-fashioned, and are probably scarcely equal in effect to those described in the more recent German works; but as in this book the blow-pipe is only suggested to be used for testing minerals, they will be found, we do not doubt, sufficient for all practical purposes. In truth, this volume is as much a treatise on minerals, from a blow-pipe point of view, as on the blow-pipe itself.

As indicated by the title, the minerals are arranged alphabetically as in Mr. Bristow's "Glossary." The names of the editors are a sufficient guarantee that this is done correctly, and as it should be; and we have consequently much pleasure in recommending this volume to practical mineralogists. Coupled with Mr. Bristow's "Glossary," to which it forms an excellent companion, both being alphabetically arranged, no one need be long at a loss to recognise any mineral species.

MR. HULL ON THE COAL FIELDS OF GREAT BRITAIN.

The Coal Fields of Great Britain; their History, Structure, and Resources, with Notices of the Coal Fields of other parts of the World. By EDWARD HULL, B.A., of the Geological Survey of Great Britain, Fellow of the Geological Society of London. With Maps and Illustrations. Second Edition, revised and enlarged. London: Edward Stanford, Charing Cross.

THE popularity of this book is in itself the best test of its value. A work on such a subject, which rapidly reaches a second edition, must be possessed of undoubted intrinsic value, and meet a recognised want. The want in this case was for a popular, yet sound, description of our coal fields, written by one well acquainted with the subject, and capable of conveying his knowledge to his readers in a popular style.

Mr. Hull's work has now reached a position which renders any detailed criticism unnecessary. It has become a standard book, which must be on the bookshelves of every one interested in any degree in the coal-industry of this country. This second edition contains much new matter, and an excellent Map of the British Coal Fields, shaded so as to show the depths at which the mineral probably lies.

Notes, Queries and Correspondence.

[We need scarcely say that we cannot hold ourselves responsible for the facts or opinions of our correspondents; although we shall make it a point to endeavour to exclude those which are obviously inaccurate or fallacious, as far as is consistent with our wish to encourage the freest discussion. It may be convenient, on the present occasion, to remind our practical readers, once for all, that the widest liberty of discussion can be enjoyed without having recourse to personalities. It is quite possible for persons to differ as widely as possible on technical or scientific subjects, and to express those differences with the greatest frankness, and yet at the same time to entertain sentiments of the highest mutual general consideration and personal regard.]

Dr. PERCY'S "METALLURGY."

Sir,—I have waited long and anxiously for Dr. Percy's book, believing from the position he holds as lecturer on metallurgy at the Government School of Mines, and having consequently the best opportunity for receiving information and testing projects and products connected with the metallurgical arts, that, when the book did appear, full justice would be done to the subject. But, whether from the length of time that has intervened between the promise and its fulfilment, my expectations had become too high, or that the Doctor has not done all he could and should have done under the circumstances, I am unable to say; but I must express my disappointment with certain parts of the book, while I am constrained to say that it is the best work on technical metallurgy in the English language. On some of the practical parts, particularly in reference to the smelting of the ore, it is defective, and shews more than anything can, that if metallurgy is to be studied properly, it must be done at the works where the practical operations are conducted.

Dr. Percy has made free use of all the information that has been printed before on the subjects he treats of, without giving (at least in my opinion) that free acknowledgment which we would have expected from a man of his position. Where the matter could not be reduced to the Doctor's standard, it has been generally treated as spurious and "roasted" at a very high temperature, except, indeed, where a connection can be traced with the Hafod Works, where all is acknowledged to be good, the Doctor having met with great kindness from the proprietors and others at these works in 1848. We would merely ask, in passing, if the Doctor did not meet with equal openness and kindness in any other works? This partiality, and the tone in which other writers are referred to, are marked defects in the book, and this spirit, as I think, will be more apparent to the practical man than to the general reader.

Some of the Doctor's strictures are aimed against practical observations made in circumstances that he has not had any opportunity of either proving or disproving, except upon certain theoretical considerations, or deductions from the results of small crucible experiments. These I am constrained to notice somewhat in detail. In one or two cases, however, the Doctor shews that *à priori* reasoning is not to be taken as evidence to disprove a positive result. For instance, after copying analyses of *blister copper* given by Mr. Napier in his papers on Copper Smelting in the *Phil. Mag.* for 1852, he says:—

"Mr. Napier remarks that the oxygen existed in the state of dioxide of copper dissolved in the metallic copper, a result which *a priori* would hardly have been anticipated, but that sulphur and dioxide of copper may co-exist in metallic copper has already been demonstrated at page 264."

This should have taught Dr. Percy to have been more charitable in his than he has been in cases where he has not had the matter to

test in his laboratory at the School of Mines. Mr. Napier, in the paper already referred to, when describing the calcination of the ores, and endeavouring to find out the reaction that takes place within the furnace during that operation, carried out a series of experiments, one set of which is disparagingly referred to by Dr. Percy with evident delight,

"Mr. Napier has published the following statements relating to the process of calcination, which, in my judgment, cannot be accepted. 'We took,' writes Mr. Napier, 'a charge of Cuba ore and calcined during twelve hours, and tried every hour, gave the following results, *(sic.)*'" I could not believe till I turned up Mr. Napier's paper that the Dr. could add *(sic)* to a mis-quotation; yet such is a fact. But to proceed with the Doctor's quotation :—

"COMPOSITION OF THE ORE."

	When put into Furnace.	In 1 hour.	In 2 hours.	In 3 hours.	In 4 hours.	In 5 hours.	In 6 hours.	In 7 hours.	In 8 hours.	In 9 hours.	In 10 hours.	In 11 hours.	In 12 houes.
Copper.........	12·3	13·0	12·2	12·2	13·0	12·2	13·8	12·6	12·6	12·5	13·2	13·8	12.2
Iron	32·7	30·0	24·4	32 8	28.7	31·3	33·6	30·6	30·0	27·6	24·3	40·3	27 0
Sulphur	31·1	28·3	23·6	18·6	29 2	24·4	12·2	18·1	20·0	15·9	18·8	17 5	16·2
Silica	24·0	28·0	32.0	28·0	26·0	28·0	34 8	32·0	30·0	30·8	33·0	21·0	40·0
	100·1	99·3	92·2	91·6	96·9	95·9	94·4	93·3	92·6	86·8	89·3	92·6	95·4

"Mr. Napier remarks—'When we take into consideration the several amounts of sulphur, we observe what appears very anomalous, that there is less sulphur at the end of six hours than after twelve. It may be asked where the sulphur has gone—whence comes it again? In all our experiments this intermitting action of the sulphur is exhibited.' He then presents an explanation of this alleged action. Now, in another experiment, the results of which are given in the very same paper as that from which the preceding extracts were taken, Mr. Napier found that the sulphur gradually diminished from the commencement to the end of the calcination, which was continued during forty-four hours. But we hardly seem to require the aid of experiment to demonstrate the fallacy of the 'intermitting action.' It is certain that during the entire period of calcination, sulphur, especially in the state of sulphurous acid, issues in a continuous current from the furnace; and as this sulphur must be derived from the ore, except the comparatively minute and quite insignificant amount which may be evolved from the fuel, it follows necessarily that its proportion in the ore must continually decrease from the beginning to the end of the process. In order that Mr. Napier's results should be of any value, it is essential that the ore operated upon should be absolutely homogeneous throughout, and that every portion withdrawn from the furnace for the purpose of analysis should be a *perfect sample;* in other words, a specimen which, for the time being, correctly represents the average composition of the ore; but it must obviously be extremely difficult, especially when operating upon large quantities of ore in furnaces, to insure this indispensable condition; and it may be proved from the very data which led Mr. Napier to admit the 'intermitting action' in question, that the successive portions of ore which he extracted from the calcining furnace, and afterwards analysed, could not have been samples."

This long extract, with its large expenditure of logic to prove certain observed facts to be erroneous, requires a careful examination, as I consider this mode of treating the labour of others in the field of practical science is not only unfair, but hurtful to the progress of that very enquiry which Dr. Percy's book is intended to advance. If the Dr. will set himself up as judge, he should be careful of the relevancy of his evidence, and sift it less partially. As the extract from Mr. Napier's paper is stopped at the part where an explanation of the results is offered, because it is unintelligible to the Dr., I will endeavour to give an explanation of the matter, which I do the more willingly, because neither Mr. Napier originally, nor the Dr. at present, have appreciated the value of the results of the experiments, and the direction for improvement which they point out. The hearth of the calcining furnace over which the ore was spread measured about 18 feet by 12 feet; the fire being at one end, there would consequently be different degrees of temperature over the hearth where the ore is spread; and from one part of this hearth Mr. Napier took out a specimen, or portion of the ore every hour, and tested it. In every series of experiments he found a less or more irregularity in the sulphur present. After making himself fully confident of the fact, Mr. Napier offers as an explanation, that from the sluggishness of the draught in these calciners, arising from reasons which he gives, and the paucity of oxygenized air present, the sulphur is sublimed from the ore at one part of the hearth, and absorbed by another portion of the ore (under certain conditions) at another part of the hearth; thus giving rise to the irregularity in the quantity of sulphur found in the ore at one part of the hearth at different periods of the process, as shewn in the above table. Unfortunately, Mr. Napier called this irregularity "intermittent," a term which may be admitted to be inaccurate, and which the Doctor makes the most of. While I willingly take the Doctor as an authority on positive results he has himself obtained, I am not inclined to take his *dictum*, without proof, against experimental facts. Mr. Napier's results, I think, point out a radical defect in the structure of the present calcining furnaces, which do not allow a ready and *immediate* escape of the sulphur whenever it is set free from the ore, whether as sulphur or sulphurous acid. In proof of this opinion I may refer to a pyrites burner, in which an ore of 50 per cent. of sulphur gives off 45 per cent. of this sulphur in less time than the copper ore-calcining furnaces will burn off one-fourth of this quantity of sulphur. Dr. Percy would have done better service to metallurgy had he pointed out some such practical applications of Mr. Napier's experiments, rather than have allowed himself to be led into disparaging strictures, founded on insufficient data.

After reading these strictures, and perceiving the spirit they indicated, I hastened on to that part of the book where improvements in copper smelting were reviewed, to see in what light Mr. Napier's process for smelting copper ores was examined, and I am sorry to see that the Dr. seems to view it through an atmosphere of copper smoke as dense as the Hafod Works could evolve, which causes him to withhold his judgment as a chemist, rather than commit himself in an opinion that might do justice to a worker in the same field, or give offence in certain quarters, or violate long-cherished partialities. In proof that the book is swayed by some influence on this head when describing Mr. Napier's process, we quote what the Dr. says:—

"The sulphate of soda being put into the furnace in admixture with coal, becomes reduced to sulphide of sodium, which is uniformly diffused through the *coarse-metal*, probably in a state of chemical combination. When the pigs are thrown into water the sulphide of sodium slowly dissolves, and the whole mass is disintegrated and reduced to impalpable powder. Now, as the sulphides of tin, antimony, and arsenic are strong sulphur acids, and as sulphide of sodium is a strong sulphur base, *was it conceived* [the italics are mine] that, in the event of any of these metals

being present in the ores, they would be dissolved out during the disintegration, and subsequent washing, in the form of solublesulpho-salts?" Why put in, "it was conceived?" The Doctor is certainly qualified, as a chemist, to say whether a strong boiling solution of sulphide of sodium will dissolve antimony, tin, and arsenic, if present in the ore; and if so, frankly admit that the process was right *in principle*; and also as openly state any practical defects, if he knew any; although these latter should be founded on proper data, not on mere reports from Swansea. The Doctor certainly does admit the possibility of some of these metals being dissolved out, for he says:—

"I examined a solution which had been obtained in this manner, and it certainly contained antimony, as might have been anticipated if that metal had been present in the ore. In the course of practice it was, I believe, found that the separation of these metals was far from complete, and from one cause or other this new process of copper smelting was speedily abandoned, and the ancient method resumed at the same works." I have no desire to enter here into the circumstances which led to the discontinuance of this process in England, nor will I enter into the evidence that is within my power of its capabilities of making copper of the best quality free from these metals referred to, and made, too, from ores that originally contained them all in considerable quantity. If the copper trade had been as open as other trades, that process, or some modification embracing the same principles, would have been generally adopted for our Cornish ores, both for purity of metal and economy in obtaining it. I will merely here state, in the interest of truth and justice, that the statement that the new process was speedily abandoned and the ancient method resumed, is a complete inaccuracy; and in making it the Doctor has evidently been led astray by incorrect and probably interestedly incorrect information. The facts of the case are these:—Mr. Napier's process was wrought in the Spitty Works for between three and four years, when the works were put under a new manager, who, to save the expense of the soda used in Napier's process, crushed the *coarse metal* into powder, under rollers in a pan mill, calcined this powder, and then fused along with it any Australian or other ores having little or no sulphur, for which process a patent was taken out by the manager and chemist conjointly, known as Trueman and Cameron's patent. This process was wrought till within a few months of the stoppage of the works, when a modification was introduced which is not patented nor referred to in Dr. Percy's book, but *at no time* was the *ancient method* resumed. That no scrap of information be lost without being put into the balance in favour of Dr. Percy's friends, it is stated that—

"The works were purchased a few years ago by Messrs. Williams and Vivian, who, it is reported, extracted from the furnace-bottoms and other cuperiferous materials on the premises a large quantity of copper in excess of the estimated amount; but whether this report be correct or not I am unable to state. It certainly is not an improbable one." Not the least improbable, considering that the estimates were made by the purchaser's agents. The reason that such a piece of information is volunteered in a book of such high character is difficult to account for. We will not suggest motives to Dr. Percy's informants; but should the book reach another edition, which I have no doubt it will, I would earnestly and sincerely suggest that the author confine his statements to matters depending more on his own and assistant's labours in the School of Mines, and trust less to interested statements.

An Old Copper Smelter.

OXLAND'S PROCESS AT EAST POOL.

SIR,—In No. 1 of the "Mining and Smelting Magazine" you give a very interesting description of the process employed at the "East Pool Mine" for separating wolfram from tin, but which you remark is a very wasteful process indeed. When the whole of the operation detailed by you is considered chemically, it is not at all strange that such a large loss of tin should result, from the fact that most of the commercial soda-ash contains a considerable quantity of caustic soda, which, when brought in contact with oxide of tin, at a red heat, will combine and form stannate of soda, which is soluble in water, and consequently would be dissolved and washed away in the after stamping and washing.

The quantity of tin lost would depend on the per centage of caustic soda contained in the soda-ash. Yours, &c.,

CHEMIST.

CANNEL AND ORDINARY COAL.

SIR,—I should be glad if any of your readers would kindly furnish particulars of any bed of cannel passing into ordinary coal, or into any other substance, when traced in particular directions. It would be important to note whether the character of the roof or floor changed at the same time, or whether any local circumstance was supposed to produce or influence the change. X. Z.

The Government School of Mines. Museum of Practical Geology.

THE following are the arrangements of the courses of lectures, to be commenced during the month of February, at the Government School of Mines. On the 10th Professor Ramsay will commence a series of thirty lectures on Geology. The first part of this course will embrace:—The agencies now changing and modifying the physical conditions of the earth;—the mineral substances entering into the composition of rocks, with an explanation of geological terms, &c.;—the origin of stratified rocks;—the nature of denudation and alteration of the earth's surfaces by aqueous agencies;—theory of the origin of salt lakes, and the elevation and depression of land;—coral reefs;—earthquake and volcanic phenomena;—theory of volcanoes, and the analogies between existing volcanoes and those of past geological periods. The mode of occurrence of organic substances in rocks, with a consideration of the process of fossilization, will conclude this division of the subject. These lectures will be delivered on Mondays, Tuesdays, Wednesdays, Thursdays, at 1 o'clock. A course of thirty lectures on Applied Mechanics will be delivered by Professor Willis, also commencing on the 10th. This subject will include the principles of Mechanics, with their practical applications:—friction;—elasticity;—strength of materials, &c.;—regulators of velocity and dynamometers;—steam engines;—and other moving powers;—general construction, arrangement, and framing of machines, with a description of their different parts;—machine tools for working in wood, metal, &c., and various other machines for direct use. These lectures will be delivered at 12 o'clock every day in the week but Saturdays. The lectures to Working Men will be continued on the 17th of February by Dr. Tyndall, who will then commence a course on the subject of Heat. Dr. Tyndall will also deliver a series of evening lectures on Light, commencing on the 27th. When we remember the admirable and complete manner in which all Dr. Tyndall's lectures (especially those which he has already delivered on light and heat) have been illustrated, we cannot doubt but that they will be largely attended, and add to that success which has hitherto rewarded the ducational efforts of the scientific staff of the Government School of lines.

Mining, Quarrying, and Metallurgical Intelligence.

THE *Colliery Guardian* gives, in its impression of the 18th January, a very important return of the total shipments of coal from ports on the coasts of England and Scotland during the past year. It is not pretended that these returns are strictly accurate, but for the greater part they are derived from the admirable list of exports originated by the late Mr. Browne, of Newcastle, whose accuracy, as far as they go, will not be questioned. Browne's list, however, omits several small ports which in the aggregate export a considerable quantity of coal, and for the figures relating to these reference has been made to Mr. Hunt's "Mineral Statistics" for 1860, and an approximating total for the past year based upon the information derived from thence. These ports are Bristol and Gloucester, Workington, Neath, Port-Talbot, Porth-Cawl, Milford, Chester, Preston, Runcorn, Fleetwood, Lancaster, Leith, Kircaldy, Dundee, and Aberdeen. The shipments being mostly coastwise, the quantity sent from these ports is estimated at 1,250,000 tons, which is a trifle less than Mr. Hunt's estimate for 1860. Last year, too, about 80,000 tons were shipped from ports distant from coal-fields, and about 100,000 tons of patent fuel were put on board ship for exportation.

The conclusion arrived at after casting up the columns is, that upwards of *nineteen millions* of tons of coals have been shipped from the coal-fields of England and Scotland during the year 1861. First of all, there are upwards of 7,000,000 tons exported beyond the seas, and nearly 10,000,000 tons coastwise, according to the figures derived from the file of Browne's list. To these may be added 1,250,000 tons from various ports enumerated above; 85,000 tons from ports distant from the coal-fields, as London, Portsmouth, Gainsborough, Rochester, Boston, and one or two others; 714,206 tons in the shape of coke and culm, and at least 90,000 tons of patent fuel. The exact figures are 19,161,615. A comparison with previous years is afforded by the following figures:—

		Tons.
Total exportation,	1861	19,161,615
" "	1860	18,159,488
" "	1859	17,218,972

showing an increase has taken place in shipments of coal at the rate of about 1,000,000 tons per year.

The following is an account of the quantity of coal shipped to London during the year, and included in the figures representing the exportation coastwise:—

	Tons.		Tons.
Newcastle	1,283,184	Blyth	46,326
Sunderland	1,057,403	Liverpool	333
Seaham	179,251	Yorkshire	30,279
Middlesbro'	5,717	Wales	124,843
The Hartlepools ...	719,948	Scotland	21,852

From various ports there have also been imported into the London market, 14,107 tons of duff; 17,751 tons of small coal; 1,281 tons of culm; and 16,687 tons of cinders. Total imports of seaborne coal into the London market, 3,567,002 tons.

The following is an account of the number of Blast Furnaces in Great Britain, and their yield of iron, in 1861:—

	No. of Furnaces in Blast.	Make of each Furnace per week. Tons.	Total Yield per Annum. Tons.
Staffordshire	131	135	919,620
Shropshire	22	130	148,720
Forest of Dean	3	150	23,400
Northumberland, Durham and Cleveland ...	58	175	527,800
West Riding of Yorkshire	25	80	104,400
Lancashire and Cumberland	14	230	167,440
Northamptonshire	3	175	27,300
Wiltshire...	2	135	14,040
Derbyshire	22	100	114,400
Total—England ...	280		2,046,720
South Wales	124	145	934,960
North Wales	5	90	23,400
Scotland	124	150	967,200
Total—Great Britain ...	533		3,972,280

CORNWALL AND DEVON.

St. Ives and Lelant Districts.—In our last number we gave a short description of the St. Just District, and of some of the mines in it. The St. Ives and Lelant mines do not present such striking features, but still the district is one of the most picturesque in Cornwall. In approaching it from the Hayle side, the landscape that opens presents an unusual combination of the sublime and the beautiful. The estuary forms a beautiful lake in the foreground, fringed with the rich woods of Trevethoe, (the ancient seat of the Pread-Tyringham family), above which rise the rugged summits of Trencrom and Trink Hills. On the right lies Lelant "town," beyond which stretch the towans or sand-hills, and the magnificent sea and coast forming St. Ives Bay.

This district, whose produce is essentially tin, is most ancient, and has on the whole been a most prosperous one. The mines are principally in the granite, in the upper parts of the parish, which is generally rough, and worth little for any other purpose. One of the most important and successful concerns in this district is the *Providence Mines*, under the pursership of Mr. Higgs, of Penzance. It was worked for many years before any profits were made; but of late years it has been giving very regular dividends—lately £1 per share (1,120) per quarter. The tin which generally occurs here, as in many other mines in the district, is rich bunches or "carbonas." The mine has every indication of great permanence, and as new and valuable ground is being now opened up, a long course of prosperity may safely be expected.

East Providence adjoins this on the east, and is worked on the same lodes. Operations have now been going on for about five years; but hitherto without success. The workings, however, are now being prosecuted very close to the Providence Mines boundary, on a lode which has been rich in that mine not very far off. As the country here is of a kindly nature, and the lode produces work for tin, great expectations are entertained of success here.

Wheal Margaret and *Trelyon Consols* are also in the neighbourhood of Providence Mines, and are promising concerns. To the west, further in the granite, lies *Worvas Downs*, a very remarkable piece of ground as to the mode in which the tin occurs.

Wheal Margaret, West Margaret, Durlo, Wheal Reeth, Wheal Kitty, Trencrom, Wheal Mary, Lelant Consols, and Praed Consols lie in the southern part of Lelant parish. *Wheal Margaret*, under the management of Captain Treweeke, is an old-established and highly respectable mine,

which keeps up its dividends well, and has every prospect of permanency, although some of the levels are extended up to the eastern boundary. *West Margaret* lies to the west of this. *Wheal Reeth* is a great old mine recently re-opened at a very heavy cost, which, however, is now nearly at an end. The levels going east of the cross-course are looking well and opening out good tin ground, which must give increased returns; while the cross-cut south to Praed's lode is being pushed on vigorously. If this lode should cut rich, which there is every reason to expect, this old mine may be expected to rival its former productiveness. The number of shares is 240. The parties connected with this mine are of the highest respectability.

Wheal Kitty is at present in a most promising position, especially in the southern workings. The Margaret levels are near the boundary, with the ends good. There is no reason why these lodes should not give good profits in Kitty, when an adequate amount of ground has been opened up on them.

Trencrom is also a promising mine; and all the necessary machinery and erections are completed to enable the returns to be made to advantage. The new north lode is opening well. The tin-stuff here is peculiar, being unusually fine in the grain; so much so that it is stated that the stamps generally turn out more than is estimated from the samples—a very satisfactory result.

Wheal Mary, adjoining Margaret, is another fine old-fashioned mine, in 100 shares, not often seen in the "market." This is a very long-established concern, having exhausted the term of several leases, and given immense profits. The levels were extended so far east of the original workings that new count-houses and offices had to be erected; but lately the mine has not been so profitable, as a hard bar of unsettled ground had to be passed through eastward. This is now passed through, and the lode here is now improving. Operations are also about to be commenced on the rich Margaret "Carn Moor" and "Foul" lodes, the ends of which are extended up to the boundary of this selt.

Lelant Consols is still poor, but is said to be looking better. It is an excellent example of the perseverance of local mining in this district, for it has now been under trial for nearly twenty years without success, If it should come, it will most certainly be well deserved, *Praed Consols* is only working on a limited scale; but tin has been recently cut, which, if it holds down, may lead to good results.

Of course this district suffers, like all other tin districts, from the fall in the prices of the metal. But still it is a great old district, which has been worked as long as our island has been known in history, and will probably be still worked when our coal-fields are exhausted. The valleys are full of records of past streaming, and there are also remains of "Jew Houses," or ancient tin-smelting works. In one case the remains of the charcoal used in the operation, and also a considerable quantity of metallic tin, in the form of small lumps like large shot, were found amongst the *débris*; and a small block of tin was found not far off.

In the St. Ives district, *St. Ives Consols* is of course the principal mine, although it has lately rather fallen off. There can be no doubt, however, that it will soon again recover its old *status*, for it is a sett of enormous resources—abounding particularly in "carbonas." *Rosewall Hill and Ransom United* adjoins this on the west, and is now looking very well. Some suspect this mine to be the coming prize of the present year; and it is an undoubted fact that some quantity of valuable tin ground is being opened up. *St. Ives Wheal Allen*, also close adjoining, is likewise a very promising concern.

WALES AND THE BORDERS.

CARDIGANSHIRE.—The following is the return of the quantities of metallic ores—lead, copper and zinc—shipped from the port of Aberystwith from the 1st January to the 31st December, 1861.

LEAD ORES.

	Tons.	Cwt.		Tons.	Cwt.
Lisburne Mines... ...	3,121 ...	14	Bronfloyd	86 ...	13
Cwm-Ystwith	1,395 ...	10	Cardigan Consols ...	69 ...	2
East Darren	1,085 ...	5	Esgair-y-mwyn ...	62 ...	5
Cwn Erfin	760 ...	8	Allt-y-crib	56 ...	8
Goginan	409 ...	17	Rheidol United ...	40 ...	13
Cefu-Crwym	289 ...	1	Bwlch Consols ...	40 ...	0
Nanteos and Penrhew ...	147 ...	2	Nant-y-cria	25 ...	17
South Darren	117 ...	12	Gro-gwynion ...	165 ...	6
Gellau-rheiron ...	90 ...	0	Sundry mines ...	156 ...	0
			Total ...	8,118 ...	13

COPPER ORES.

	Tons.	Cwt.		Tons.	Cwt.
Cardigan Consols... ...	41 ...	2	Caradoc...	6 ...	7
South Daren	26 ...	10			
			Total ...	73 ...	19

BLENDE.

	Tons.	cwt.
Lisburne Mines	63	0
Befn-brwyno	42	0
Cwm-ystwith	84	0
Rheidol United	227	0
Nant-y-cria	275	0
Total ...	691	10

This, we believe, comprises all the exports from the Cardigan mines, except 67 tons 5 cwt. shipped at Aberayron from the Llanfair mines. Among all these mines, the first four in the list—Lisburne mines, Cwmystwith, East Darren, and Cwm-erfin are alone working to a profit.

We referred last month to the unfortunate result of most of the mining trials in Cardiganshire, during the last twenty years, except those conducted under the management of Messrs. Taylor. Besides those under the management of this eminent firm, there are, however, others which are being prosecuted with *bonâ fide* intentions, and which promise good results. Among these we may mention those under the management of Mr. Murchison and Mr. W. Spooner. *Rheidol United* and *Eaglebrook* are being wrought quietly, but still with miner-like vigour. *East Darren* is opening out an excellent piece of ore ground in the 20-fathom level west, with backs continually increasing. *South Darren* is opening out very favourably. The 80 west is worth 10 cwts.; 80 east, 9 cwts., 70 east, 1 ton; and 20 west, 12 cwts. of lead and 1 ton of copper ore per fathom. The lead ore realizes upwards of £16 per ton even at present depressed prices. The mine adjoins East Darren and Cwm Errfu, two good dividend mines. *Allt-y-crib* is being extended from the old washings on a lode producing one ton of copper ore per fathom. *Bwlch Consols* is opening out a comparatively new mine, and is rapidly increasing its reserves of ore. *Car-*

digan Consols and *Nanteos and Penrhiw*—mines in Mr. Murchison's office—seem only to require a proper outlay of capital to make them substantial paying concerns. Since we have known the district—about eighteen years—the mines have always been held in the highest estimation by those capable of forming the best judgment from a long experience; but, although worked off and on for all that period, they have yet failed to yield any substantial results; entirely, we believe, from the want of sufficient capital.

Indeed, in this respect—the necessity of having ample capital—the Cardiganshire mines occupy a position not usually understood. Of any metallic mining district in the kingdom, this, above all others, requires the application of abundant capital. In the majority of instances, even in the cases of the most profitable mines, the lead ore occurs considerably disseminated among ganguey matters; and consequently a considerable field of machinery is required to return it. Here it is not as in the limestone districts of North Wales, where the ore occurs comparatively solid and clean, and where the dressing is the simplest possible operation. The operations of dressing in Cardiganshire are costly and complicated—more nearly allied to those pursued in tin-dressing in Cornwall than any other. The mines are certainly worked by water power, and the hilly nature of the country gives considerable opportunity for adit levels; but this use of water power itself involves generally a heavier preliminary outlay of capital than the erection of steam power would, except in some exceptional cases where a considerable stream is immediately available. Extensive pounds and long leats have to be made, so as to insure a continuous supply throughout the dry season; and if this is not done effectually the mine will be idle a large proportion of its time, and effectual working be out of the question.

Hence, in cases where prospectuses promise *immediate* profits in this district, caution should be observed. It is not the characteristic of the district to afford rich and pure bunches of ore, from which profits can be made under the most disadvantageous circumstances. The ore occurs with considerable regularity, but much mixed up, and can rarely if ever be wrought with profit unless after being laid open on a large scale, with proper reserves. The smaller mines in the district do not do this—and hence they necessarily fail.

In this district, as throughout Wales generally, the mines are worked on the limited liability system. The difficulty of the application of this system to mining is, that the nominal capital is frequently fixed too low, and when this is spent, as no more can be called up, the concern is brought to a dead lock. This fixing of a low amount of nominal capital is a great mistake. The nominal capital, under the limited liability system, is not intended to be fixed exactly at the estimated amount required; it is intended rather as a limit of the possible liability of the shareholders, and hence should be fixed far above the estimate. If this had been done in the case of some Cardiganshire companies, much subsequent difficulty would have been spared. The fault rests, we think, rather with the public than the managers. If a large nominal capital is fixed, they are scared from the undertaking—just as if fixing this nominal capital as a possible limit, beyond which liability cannot extend, necessarily implied its being immediately called up and expended.

When companies get into this dead-lock of having called up all their capital, great difficulty is generally met with in devising means for procuring the additional amount necessary. In the case of Nanteos and Penrhiw a new method has been adopted. In this mine 472 shares have been forfeited; and these the directors propose issuing at £3 each, payable by instalments; this £3 to be returned out of the first profits, after which the shares will still rank equally, for all purposes, with the other shares. This seems a very fair proposition in the interest of all parties, and will probably be followed in the case of other concerns.

South Wales.—The authorities of two or three of the principal shipping ports of South Wales have just issued their official returns for the year 1861; and although the statistics for Cardiff (the principal port of export both for coal and iron) show a slight decrease as compared with the year 1860, yet we have reason to congratulate ourselves that, upon the whole, a very steady and satisfactory business has been done, and that the returns do not exhibit such a general depression of trade as some alarmists wished to make out. The latter half of the year 1860 was a very extaordinary one, the shipments of coal being more active and brisk than ever before experienced in the history of the district; and this fact should be taken into consideration when looking at the general state of trade for the past year. During the past month of December Cardiff exported 92,447 tons of coal, and 8,321 tons of iron; whilst for the month of December, 1860, there were exported 93,906 tons of coal, and 10,860 tons of iron; and in 1859 103,089 tons of coal, and 4,781 tons of iron. The exports to foreign parts for the past year of 1861 were 1,123,657 tons of coal, and 132,493 tons of iron; for 1860, 1,142,366 tons of coal, and 169,467 tons of iron; and for 1859, 968,187 tons of coal, and 182,827 tons of iron. This is exclusive of the shipments coastwise, so that the total export of coal from the port of Cardiff for 1861 may be stated to be about *two millions* of tons, and about 200,000 tons of iron. The official returns for the port of Newport have not yet appeared, but we are in a position to state that there is not a very serious falling off in the returns, although undoubtedly Newport has been the most to suffer consequent upon the general depression of trade. The returns of Swansea are published in another form, but they equally prove the prosperity of the port during the past year as compared with that of the predecessor. From the statistics before us it appears that the receipts for the month of December last were £1,126. 8*s*. 0½*d*., as compared with £1,106. 19*s*. 0½*d*. received during the corresponding month of 1860. The number of vessels entering the port during the month was 390, as compared with 387 during December, 1860. The total trade for the year ending 31st December, 1861, was as follows:—Number of vessels 5,700, with a registered tonnage of 620,151, and the total shipping rates received £14,482. 3*s*. 3*d*. The trade of 1860 was 4,891 vessels, with a registered tonnage of 532,355 tons, and the rates received were £13,419. 2*s*. 7*d*., or an increase upon the year of 809 vessels, 87,796 tons, and £1,063. 0*s*. 8*d*. tolls. These returns do not include the very large number of vessels which arrive in the port in ballast for cargoes, but from a computation which has been made, we believe we shall not be far wrong in stating that upwards of a million tons of coal and general merchandise has been exported from Swansea during the year just ended. During the past year the extensive docks at Briton Ferry have been opened, which has given a great impetus to the shipment of coal and iron at that port, more especially in the coasting and European trades. The official returns have not yet been prepared, and the same remarks apply to Neath and Llanelly, but we are in a position to be able to state that they will each show a considerable increase of trade as compared with the previous year.

NORTHERN COUNTIES.

In the Newcastle district all attention is absorbed in the terrible accident at Hartley New Pit. The scene of the catastrophe, and an outline of the history of the colliery, is thus given by the *Newcastle Daily Chronicle*:—"'Hartley' is the name by which the 'steam coals' of the Great Northern Coal Field are generally known, in the same way as 'Wallsend' is the name by which our northern 'household coals' are popularly described. The name given respectively to these two classes of coals simply arises from the special kinds of coals being found, one at and near Hartley, and one at and near Wallsend. When coal owners or factors talk of 'Hartley

coals,' they are understood to mean coals well adapted for raising steam in marine and other boilers; and when they talk of 'Wallsend coals,' they mean coals well adapted for house purposes. The collieries in this district from which steam coal is got are situated along the Northumberland seaboard, extending from about Killingworth to near Warkworth. Hartley, Burradon, Seghill, and Cowpen, are four of the chief steam collieries in Northumberland. Seghill is the oldest of the lot. It was sunk about forty years ago, about the same time as the neighbouring colliery of Cramlington. It was fully expected, when these mines were put down, that coal of the quality and value of the main coal seam at Wallsend and Gosforth would be obtained. The owners were, however, disappointed in their expectations in this respect, and for some time it was feared that the undertakings would be entire failures. The value of steam coals was not then known, and it was not for some years after that their real worth was discovered. When that became known, the value of Seghill and all the surrounding collieries rose very rapidly. Now, and for a number of years past, it is well known that the collieries in that part of Northumberland have been the most valuable in the north of England. Messrs. John Carr and Co. were the lessees of all the above four collieries up to 1858. But in that year, owing to the disastrous effects the commercial panic of 1857 had upon their property, the Messrs. Carr were compelled to relinquish possession of them. The four collieries were sold by public auction in Newcastle, on July 20th, 1858. Seghill, which is situated about six miles north of the Tyne, was bought by Mr. Joseph Laycock. The colliery stock and plant alone was valued at £22,392. 4*s.* 11*d.* The whole concern, including the land attached—about 800 acres—farm stock and lease, &c., brought £93,000. Cowpen Colliery is situated near Blyth, and about eleven miles north from the Tyne. This colliery, having 304 workmen's cottages, and the lease of a farm containing 107 acres attached, was purchased by Messrs. Jos. Straker and partners for about £120,000. Burradon Colliery lies to the west of Seghill, but is about the same distance from the Tyne. It was sold to Mr. Joshua Bower, of Leeds, for £50,000, including workmen's cottages and other erections. Hartley Colliery is in the parish of Earsdon, and is nearer the coast than either Seghill or Barradon, but not more than six or seven miles direct north from the Tyne. It is an old-established concern, and was worked by Messrs. John Jobling and partners before it came into the possession of the Messrs. Carr. There are three seams in the mine. The High Main, at a depth of 38 fathoms, is four feet six inches thick. This seam is all but worked out. The Yard Coal is at a depth of 65 fathoms, and, as its name indicates, is a yard thick. The Low Main Seam, which is the present working one, is about 95 fathoms deep. It was sunk in 1830, a previous shaft, 80 fathoms deep, having been abandoned. The coals are chiefly shipped at the artificial harbour of Seaton Sluice, by a private railway of about two miles long. The colliery is held under an agreement for lease from Lord Hastings for twenty-five years, from May 1st, 1844, and comprises about 3,000 acres of coal. The certain rent is £1,200 per annum for the first three years of the term, and £2,000 per annum for the residue of the term. The lessees may surrender at the end of any year, with power to make up 'shorts,' of which £13,000 were estimated as due in 1858. At the public auction of the other three collieries, in 1858, Hartley was withdrawn, arrangements having been made with Lord Hastings for the Messrs. Carr to continue working the concern. The vend is estimated at from 90,000 to 100,000 tons. When the above collieries were disposed of, all of them except Burradon were sold subject to an agreement with the Tyne Improvement Commissioners that all the coals shipped by them in the River Tyne should be shipped in the Northumberland Dock during the existing lease or any renewed leases not exceeding fifty years from March 28th, 1852. In 1858, when the three collieries—Seghill, Burradon, and

Cowpen — were sold, their aggregate vend of large coal was not less than 410,000 tons. Since the commercial panic in 1857, the Messrs. Carr have been most unfortunate. At that time they ranked amongst the foremost men in the northern coal trade. Since then misfortune after misfortune has followed them. Not two years ago the calamitous explosion at Burradon took place, when the colliery was under the charge of Mr. Charles Carr, and now this said accident at Hartley has befallen them. Very general sympathy is felt for them in the district, although, at the same time, the system of working so large a colliery with only one shaft, is very widely condemned, and government interference with the plan, which is not uncommon, is talked about in various, though not influential quarters. In the present instance, blame is attributed to the managers, for not continuing the 'staffle,' with its ladder, to the high main seam, in which case it is believed that the unfortunate men could have been rescued in a few hours. With respect to the future of the colliery, it is thought that no attempt will be made to work it again, at all events not in the present condition of trade. It has never been a very profitable concern, and this accident will involve an outlay which it may not be thought worth while to invest. The particulars of the accident are too well known to require any description here. With regard to the shaft itself it was of very capacious dimensions, divided at the centre by a wooden brattice through its entire length, thus dispensing with a second pit. Adjoining the pit on the east side is the engine-house. Ever since its formation Hartley New Pit has been subject to floods, and it is only very recently that by means of most ponderous machinery the miner has been enabled to continue his labours. Some six or seven years ago, the colliery was completely inundated in consequence of the machinery being too light for the feeder, and was obliged to be laid in. About four years ago the present pumping engine, the largest of its kind we believe in the north of England, was erected. The beam weighs no less than forty tons. Still, notwithstanding the matchless machinery, the water continued to inundate the workings, For a time it was thought that the sea must have been struck, and the abandonment of the colliery was all but decided upon. It was only since they holed into the old workings of the 'Mill Pit' that the owners have had the satisfaction of seeing their expensive undertaking free of water, and of receiving some remuneration for their capital. The accident occurred about ten o'clock on Thursday morning, January 16th. Had it taken place a little later on in the day, its effects would have been comparatively trifling, for the night shift being in process of coming to bank, the pit in a short time would have been deserted. Out of the 200, however, whose hours of labour had expired, only sixteen had left the shaft, and eight more were at the moment being drawn to the bank in the cage by means of the winding machine. When about half way up, the ponderous beam of the engine snapped at the axle, and the outer half—a mass of iron upwards of twenty tons in weight—fell sheer down the shaft. The falling mass appears to have first struck the brattice, which it smashed and scattered like chaff in its downward career. The iron cage, in which the men were riding to the top, was shattered, and its unfortunate inmates overwhelmed by an avalanche of *debris*. Two of the unfortunate men were instantly killed and precipitated to the bottom, while three others lingered only a very short time after being struck. The remaining two were also injured, but not seriously, and after the expiration of twelve weary hours, during which every exertion was made to save them, they were ultimately rescued and brought to the bank. One lad, named William Sharp, managed to climb half way up the pumps, and there held on until relieved.

It was soon found that the portion of the shaft above the yard-seam had been completely blocked up with the *debris* broken by the fall of the beam, and that upwards of 200 men and boys had been buried alive.

The noble efforts made to save these, and the unhappy failure of all these endeavours, are matters of history, which will live longer in the minds of English people then the records of many battles and sieges. All the bodies of the men in the Yard seam were recovered by Sunday, the 26th. A good deal of discussion has already taken place in the newspapers on this lamentable affair; but we prefer reserving any observations on it until after the official inquiry which will take place. It must be remembered that the accident is one almost without precedent.

THE IRON TRADE OF NORTHUMBERLAND, DURHAM, AND NORTH YORKSHIRE. —From the circular of Mr. Hoyle, of Newcastle, we make the following extract respecting the increasingly important trade of Northumberland, Durham and Cleveland:—Referring to that now great rival district on the north-eastern coast of England, and in the proceedings of which much interest is now felt by the trade, what are the results which may be reported from the operations of last year? The number of furnaces that have been in work, for longer or shorter periods throughout the year, is 66. The aggregate produce of pig-iron from these furnaces may be estimated at 607,000 tons. The present number in operation is 60, and there are now 40 furnaces out of blast. The disposal of the pig-iron made may be stated as follows:—

		Tons.
Total stock, January 1st, 1861		62,000
Make during the year		607,000
		669,000
Shipped for exportation abroad	103,000	
Used in the rolling mills and foundries in district, shipped for delivery coastwise, and sent away by rail	506,000	
		609,000
Total stock in the hands of makers and in store, January 1st, 1862		60,000

These statistics, compared with those of the previous year, show the following results:—That 66 furnaces in all have been employed in place of 68, and that the make has been curtailed by about 26,000 tons. That 60 furnaces are now in blast, instead of 65 at the close of 1860. The foreign exports show an increase of 38,300 tons compared with the foreign shipments of 1860, and the home consumption a diminution of something like 74,300 tons. The stocks are two thousand tons less than they were twelve months ago, and from their insignificance, contrast strikingly with the enormous stocks on hand in Scotland. It may be asked, Why this amazing discrepancy? The answer is simply this, that in the north of England there exists no class of buyers, as is the case in Scotland, intermediate between the producer and consumer: the consequence is, that beyond the ability or inclination of the maker to hold, the manufactured article passes directly from the furnaces into consumption. In the absence of the artificial element that prevails in Scotland, the make of pig-iron is regulated by the demand for consumption, and thus the large stocks that press so heavily on the Scotch market are avoided. Here, as in Scotland, the large number of furnaces ready to light on the revival of trade must for some time keep in check any tendency to an advance in price; whilst, on the other hand, it may be stated that in the Cleveland locality large rolling mills in connection with some of the furnaces have been built, and others are in course of erection, the effect of which will be to take out of the market a large portion of the pig-iron made in the district. Throughout the year, the quotations issued from an official source have ranged from 50*s*. to 47*s*. 6*d*. for No. 1, and from 45*s*. to 44*s*. for No. 3, shipped free on board. The present quotations are 50*s*. No. 1, and 44*s*. No. 3.

Mining, Quarrying, and Smelting Accounts and Meetings.

CORNWALL AND DEVON.

At the Clifford Amalgamated Mines (Dec. 18th), the accounts showed—Mine cost, Sept., £2,413. 3*s.* 11*d.*; Oct., £2,722. 13*s.* 5*d.*; tributers' balances, £307. 11*s.* 7*d.*; merchants' bills, £2,870. 11*s.* 7*d.*; coals, on account, £1,390; Redruth and Chasewater Railway bill, £258. 15*s.*; Clifford adventurers' materials, £236. 13*s.* 8*d.*; United Mines ditto, £107. 12*s.* 4*d.*; Trefullack ditto, £19. 3*s.* 9*d.*; ticketing expenses, £11. 14*s.* 11*d.*=£10,338. 0*s.* 2*d.*—Ore sold and sundries £9,202, 7*s.*; leaving debit balance, being loss, £1,135. 13*s.* 2*d.* Captain John Richards reported that Wheal Clifford district was looking very well. In United Mines, though very poor at present, there were several points to explore which held out encouragement for future success. The accounts, as was expected, show a loss of rather more than £1,100; to account for this, there is but one month's ore credited against two months' cost; and the bills have been very heavy, so as to get the machinery above and below ground in a proper state of working. At the next account they will pay off this debt on the book, and leave from £2,000 to £2,500 profit.

At Rosewall Hill and Ransom United Mines (Dec. 23), the accounts for the three months ending Oct. shewed—Balance last audit, £357. 9*s.*; tin sold, £1,753. 5*s.* 10*d.*=£2,110. 14*s.* 10*d.*—Mine cost, merchants' bills, and sundries, £1,546. 6*s.* 4*d.*; leaving credit balance, £564. 8*s.* 6*d.* The profit on the three months' working was £206. 19*s.* 6*d.* Capts. Treweeke and Thomas reported favourably upon the position and prospects of the mine.

At East Devon Great Consols Mine (Dec. 30th), the accounts showed—Balance last audit, £32. 16*s.* 10*d.*; mine cost, four months ending November, £662. 8*s.*; sundries, £5=£709. 4*s.* 10*d.*—By calls, £373; leaving to debit, £327. 4*s.* 10*d.* A call of 3s. per share was made. Capts. T. Neill and T. Richards, in reporting on the mine, say—"The 40 fm. level cross-cut south has been extended altogether about 30 fms., and two lodes found therein, which are composed of beautiful spar, mundic, and copper ore. We are extending on the last lode met with; its appearances are very favourable, in good ground for mineral, and its direction being very fast south of east. In about 20 fms. more driving it will form a junction with the south copper lode, which in the Devon Consols, within the last few months, has been found and still continues very productive for copper ore. This must be considered as a highly favourable feature for East Devon, and we do not see (to ensure the same results) any better course to adopt for the future than to continue on the present operations; and seeing such a change for the better has taken place in the character of the lode at the 52, we are sanguine that an extension westward at this level, driving the 40 to intersect the south copper lode, and cutting the lode at the 64, will open up a valuable and productive mine. The operations progress favourably, and the engine and pit-work are in good order and working well.

At Budnick Consols (December 30—Rev. E. J. Treffry in the chair), the accounts for the four months ending September showed—Balance last audit, £,2544; mine cost, merchants' bills and sundries, £3,073. 12*s.* 9*d*, =£5,617. 12*s.* 9*d.*—Calls received, £1,697. 9*s.* 7*d*; tin sold, £1,307. 5*s.* 4*d.*: leaving debit balance, £2,612. 17*s.* 10*d.* A call of 10*s.* per share was made. The committee reported that since the last meeting capitalists of high standing have purchased shares to the extent of one-fifth of the whole mine. The Duchy of Cornwall have liberally consented to reduce the rate of dues since September, 1860, from 1-18th to 1-60th dish, and the committee think that the other lords of the soil would benefit themselves as well as the adventurers by consenting to similar reductions. Captains Puckey and E. Dunstan have inspected the mine, and have reported favourably upon it; and Captains Evans and Mitchell, the agents of the mine, state that the stopes are yielding moderate stamping work; the tribute pitches on the whole are improved since last account, and returns will probably be increased when the 40 and 50 fathom levels are drained.

At the Pendeen Mine (December 31—Mr. Bawden in the chair), the accounts for the two months ending December showed a loss of £374; and a general statement of assets and liabilities showed a balance in favour of the mine of £1,104.

At ASHBURTON UNITED MINES (December 31—Mr. John Arnold in the chair), the accounts for the three months ending November showed—Balance last audit, £1,250. 0s. 1d.; mine cost, merchants' bills and sundries, £2,386. 9s. 4d. = £3,636. 9s. 5d.—Tin sold, £1,288. 2s. 7d.; calls received and sundries, £1,837. 1s. 7d.: leaving debit balance, £511. 5s. 3d. Capt. Wm. Edwards reported that the number of hands employed was 150. The 24-inch cylinder engine and boiler are complete, is all on the mine, and the rest of the machinery and surface operations are working satisfactorily.

At NEW WHEAL SETON (December 31), the accounts for four months ending October showed a debit balance of £218. 13s. 11d., and a call of 30s. per share was made. The shaft is down 7½ fathoms under the 42, where they have a promising lode; the other levels are looking very encouraging. Surrounded by good mines, there is little room to doubt of this becoming equally productive when fully developed.

At EAST GUNNISLAKE and SOUTH BEDFORD MINES (December 31—Mr. W. A. Thomas in the chair), the accounts for the three months ending October showed—Balance last audit, £374. 11s. 11d.; ore sold and carriage, £369. 0s. 11d.; calls received, £641. 7s.=£1,384. 19s. 10d. Mine cost, merchants' bills and sundries, £1,261. 14s. 1d.; leaving credit balance, £123. 5s. 9d. Messrs. W. G. Gard and J. Phillips reported that they had the same elements of success in view as made Gunnislake, Luscombe, and Wheal Crebor so profitable.

At the WHEAL BASSET AND GRYLLS (Dec. 30), for the three months ending October, the accounts showed—Ore sold, Oct., £643. 11s. 8d.; Nov., £951. 4s.; Dec., £2,306. 19s. 3d.; extra price for tin sold Sept. 30th, £18. 14s. 6d.= £3,920. 9s. 5d.—Balance last audit, £282. 12s; mine cost, Aug., £848. 13s. 4d.; Sept., £830. 10s. 5d.; Oct., £816. 16s. 3d.; merchants' bills, £865. 1s. 1d.; dues, £172. 10s. 2d.; surgeon's pence, £17. 9s. 6d.: leaving credit balance, £86. 16s. 8d. The profit on the quarter's working was £369. 8s. 8d. Captain Wilkin's salary was fixed at 12 guineas per month. It was resolved that the arrangement made by the deputation (appointed at the meeting of adventurers) with the several lords for the reservation of 1-20th dues in the several setts—1-24th to be received during pleasure—be approved and confirmed; and that the grantees be authorised and requested to execute the several counterparts of the setts. The report of the agents (Capts. J. B. Wilkin, W. Harris, and S. Tredinnick) stated that the total number of hands employed was 318, out of which there were 75 men on tutwwork, and 50 tributers. Upon the whole the mine was in a fair way of developing itself, and they hoped when the eastern part of the mine became productive to return profits.

At SOUTH WHEAL FRANCES (Jan. 6), the accounts for October and November showed a credit balance of £2,423. 11s. 7d. The profit on the two months was £499. 18s. 1d. A dividend of £496 (£1 per share) was declared, and £1,927. 11s. 7d. carried to credit of next account.

At GRAMBLER and ST. AUBYN MINES (Jan. 7), the accounts for Oct. and Nov. showed—Balance last audit, £179. 10d.; mine cost, merchants' bills and sundries, £643. 4s.=£822, 4s. 10d.—Calls received, £486; copper ore sold (deducting £12. 10s. 3d. dues, at 1-18th), £212. 14s.: leaving debit balance, £123. 10s. The loss on the two months' working was £430. 9s. 2d. A call of £1 per share was made. Application will be made to the lords for the remission of their dues. Capts. J. Davey and J. Mitchell reported that they had not cut the lode in the 25 cross-cut, south of engine-shaft, but hope to do so shortly.

At NORTH TRESKERBY MINE (Jan. 7), the accounts for the three months ending November showed—Balance last audit, £1,218. 1s. 4d.; copper ore and tin-stuff sold, £2,197. 1s. 9d.=£3,415. 3s. 1d.—Mine cost, merchants' bills, and sundries, £2,639. 11s. 9d.: leaving credit balance, £775. 11s. 4d. The apparent loss of £442. 10s. arises from three months' cost being charged against two months' ore money.

At the COOK'S KITCHEN MINE (January 7), the accounts showed a credit balance of £941. 17s. 4d., and a dividend of 7s. per share was declared.

At the MARKE VALLEY MINE (January 8th), the accounts for the three months ending November showed—Balance last audit, £3,780. 1s. 4d.; ore sold £5,892= £7,672. 1s. 4d.—Mine cost, £2,882. 17s. 2d.; lords' dues and sundries, £560. 5s. 7d.; dividends paid, £2,221. 5s.: leaving credit balance, £4,007. 13s. 7d. A dividend of £2,000 (6s. per share) was declared. As the November ores realised £1,694. 8s. 2d. there remains, after payment of this dividend, £2,890. 15s. 9d. to credit of the next account.

At East Caradon Mine (January 8th), the accounts for the three months ending December showed—Balance last audit, £1,870. 1*s.* 4*d.*; ore sold, £6,557. 10*s.* 7*d.* =£8,427. 11*s.* 11*d.*— Mine cost, merchants' bills, sundries, £2,302. 17*s.* 4*d.*; leaving credit balance, £6,124. 14*s.* 7*d.* A dividend of £4,608 (15*s.* per share) was declared, and £1,516. 14*s.* 7*d.* carried to credit of next account.

At the Wheal Jane (Kea) (January 10), the accounts for September and October showed—Balance last audit, £811. 6*s.* 1*d.*; ores sold, £2,316. 12*s.* 2*d.*; due on mundic overcharged end of June, £1. 4*s.*; debts, &c., from tributers, £2. 11*s.* 11*d.*; errors in Messrs. Vivians and Treglown's bills, £7. 7*s.* 7*d.*=£2,636. 17*s.* 1*d.*—Mine cost, merchants' bills, &c., September, £575. 0*s.* 2*d.*; October, £774. 15*s.* 9*d.*; dues and returning charges on tin ores, £145. 3*s.* 1*d.*; overcharged on mundic, £18. 6*s.* 2*d.*; discount on ore bill, £3. 4*s.* 5*d.*: leaving credit balance, £1,120. 7*s.* 6*d.* Upon the two months' working there was a profit of £811. 6*s.* 1*d.* A dividend of £512 (£1 per share) was declared, and a balance of £608. 7*s.* 6*d.* carried to the credit of the next account. The report of the agents (Capts. T. Bray and W. Giles) recommended that a perpendicular shaft should be forthwith sunk to the north of Gilbert's shaft. The tribute department was looking fair, and they had 18 pitches working, at from 3*s.* 3*d.* to 13*s.* in £1; employing 54 men and two boys; 12 tutwork bargains employing 39 men and 35 boys. From the prospects of the mine, and the sacrifice made by selling their tin-stuff, they believed they were justified in recommending the purchase of a steam-stamps, whenever an opportunity presented itself, having already made the necessary preparations at the steam-whim for the connection of the same. Agreeably with the recommendation contained in the report, it was agreed, upon the proposition of Mr. Treseder, seconded by Mr. J. Tonkin, that a perpendicular shaft should be forthwith sunk to the north of Gilbert's shaft.

At Rosewarne United Mines (January 13), the accounts showed—Mine cost, merchants' bills, and sundries, £1,616. 0*s.* 10*d*; balance from last audit, £13. 5*s.* 5*d.*; copper ore and tin-stuff sold, £1,569. 4*s.* 5*d.*: leaving debit balance £33. 11*s.* Capts. T. Richards, Woolcock, and Carthew, reported that there were employed underground 52 men on tutwork and 60 on tribute.

At North Roskear Mine (January 14), the accounts showed—Ore sold, £3,092. 6*s.* 6*d.*—Balance last audit, £21. 6*s.* 8*d.*; mine cost, merchants' bills, and sundries, £2,975. 11*s.* 7*d.*; leaving credit balance, £95. 8*s.* 3*d.* Capts. Vivian, Dunkin, and Angove, reported upon the various points of operation; they calculate a small profit at their next two-monthly account.

At the Tryphena Pendarves Mine (January 14), the accounts for four months ending November showed a debit balance of £1,559. 1*s.* 3*d.* and a call of 30*s.* per share was made. Capts. R. Pryor and J. Rule reported:—"Twelve heads of stamps are in course of erection, to be attached to the water-wheel, which we hope will be working within three weeks. The engine continues to work well, and keeps the water with about four strokes a minute."

At the New Godolphin Mine (January 15.—Mr. Frederick Hill in the chair), the accounts showed—Tin sold, Oct., Nov., and Jan. (per contract), less dues, £48. 7*s.*—Mine cost, Oct., Nov., and Dec., £39. 15*s.* 11*d.*: leaving profit upon the three months of £8. 11*s.* 1*d.* The report of Capt. James Pope stated that, looking at the sett generally, together with the appearance of the strata, cross-courses, and elvans, and the junction of granite and killas, he did not hesitate to say it was one of the best pieces of mining ground now idle in Cornwall, and could recommend it as such to any company of gentlemen inclined to speculate in mining. The report of Capt. Nicholas Tredinick was to the effect that the sett was worthy a fair trial.

At Wheal Buller (January 21), the accounts showed—Balance last audit, £648. 5*s.* 4*d.*; copper ore sold, £1,317. 0*s.* 11*d.*; tin, £1,449. 10*s.* 11*d.*; sundries, £72. 2*s.* 10*d.*=£3,487.—Mine cost, November and December, £1,856. 16*s.* 6*d.*; merchants' bills, £759. 2*s.* 3*d.*; dues, £172. 18*s.* 2*d.*: leaving credit balance, £698. 3*s.* 1*d.* Upon the two months' working there was a profit of £49. 17*s.* 9*d.* The report of the agents (Captains J. Davey, J. Johns, and J. Uren) stated that, from the appearance of the mine at the last account, they thought they might have been able to make a small dividend upon the present occasion, but the tin-stuff had not proved so good as they then anticipated, and the fall in the price of tin had prevented it. The costs for the future would rather exceed that of the present two months. More men would be required to develop the north lode at Stevens's.

At West Basset Mine (January 22), the accounts for October and November

showed—Labour cost, £2,050. 8*s*. 1*d*.; merchants' bills, £1,342. 2*s*. 10*d*.; tribute, £1,329. 12*s*. 8*d*.; royalty, £323, 18*s*. 7*d*.; advance on tribute, £400; new engine, £1,400; sundries, £30. 8*s*. 7*d*.=£7,678. 10*s*.—Balance last audit, £2,142. 4*s*. 3*d*.; received advance on tribute, £300; materials sold, £186. 14*s*. 5*d*.; fines, £1. 5*s*.; copper ores sold, £5,048. 6*s*. 4*d*.: leaving credit balance, £801. 19*s*. 3*d*., which, together with ore bills not yet at maturity, amounts to £7,139, 12*s*. 6*d*., applicable to the general purposes of the mine. Capt. Roberts reported favourably upon the prospects in sinking Grenville's shaft, and estimated the next sampling to be about 480 tons.

At the Wheal Kitty, St. Agnes (January 23), the accounts showed a loss upon the three months' working of £92. 15*s*. 10*d*. The report from Capt. R. Pryor was considered of the most satisfactory character. It stated that the new lode cut in the 54 cross-cut south was worth £15 to £20 per fathom, and that it might be intersected from every level, above and below. As the 54 was the most western end in the mine, he considered the cutting of this lode would have a most important effect upon the welfare of the mine.

The directors of the Devonshire Great Consolidated Copper Mining Company, at their board meeting (January 24), declared a dividend of £8,192, being £8 per share, arising from profits on sales of copper ores sampled in the months of September and October, last. After payment of the same there remains in hand a balance of £24,244 19*s*. 6*d*. in cash, ore bills not at maturity, and reserved fund, applicable to the general purposes of the company.

WALES.

At Bryn Gwiog Mine (January 22), the statement of accounts showed—Call received, £500; Ore sold, £1,344; sale of old materials, £19. 3*s*. 5*d*.=£1,863. 3*s*. 5*d*.; balance last audit, £214. 0*s*. 5*d*.; mine cost, October, November and December, £1,052. 19*s*. 9*d*.; merchants' bills, £219. 8*s*. 3*d*.; doctor's pence, &c. £3. 1*s*. 4*d*.; dues, £80. 17*s*.; interest and discount, £22. 19*s*. 10*d*.; incidental expenses, 18*s*. 8*d*.=£1,594. 5*s*. 3*d*.; leaving credit balance, £268. 18*s*. 2*d*.

At the Vigra and Clogau Mine meeting (January 24,—Mr. Martin in the chair) the accounts from the commencement of the workings to December 31, showed—Capital subscribed, £11,550.; gold sold (2,886 ozs. 3 dwts., yielding 2,784 standard ounces), £10,816. 17*s*. 2*d*.; balance of interest, £1. 12*s*. 3*d*.; debts and liabilities, £796. 8*s*.=£23,164. 17*s*. 5*d*.—Plant and machinery, £11,554. 14*s*. 11*d*.; May, July, and October dividends paid, £3,675.; royalties, rent, and fees, £1,091. 3*s*. 1*d*.; working expenses, 12 months to January 1 last, £1,931. 0*s*. 10*d*.; leaving credit balance (including gold on hand, £4,796. 12*s*. 2*d*.), £4,912. 18*s*. 7*d*.. A dividend of £3,150 (15*s*. per share), free of income tax, was declared. Mr. W. H. Ashurst was elected a director. The yield for the last fortnight has been 193½ ozs., being an excess of about 13 ozs. on the previous return.

COLONIAL AND FOREIGN.

At the Port Philip and Colonial Gold Mining Company meeting, on Wednesday (January 8th,—Mr. J. D. Powles in the chair), the accounts showed a balance standing to the credit of profit and loss of £24,780, out of which a dividend of 1*s*. 6*d*. per share was made (forming with the distribution of 1*s*. per share declared in July last, the fourth dividend), and being at the rate of 12½ per cent. per annum. A vote of £500 was passed to the three original directors—Messrs. J. D. Powles, Sir C. H. J. Rich, and Captain J. Vetch, R.E.,—in consideration of their gratuitous services from 1852 to 1858. The retiring directors and auditors were re-elected. The company's proceedings have gone on at Clunes without interruption. The quantity of quartz crushed between October 1, 1860, and September 30, 1861, has been 32,258 tons, from which the produce has been 24,336 ozs. 6 dwts., being an average of 15.2 dwts. per ton. The quantity crushed during the preceding year was 21,694 tons, and the produce 17,466 ozs., being an average of 16 dwts. per ton; showing an increase in crushing of 10,564 tons, and an yield of gold of 6,870 ozs. over the same period of the previous year. It will be perceived that the yield of gold per ton has experienced a variation of 22 grs., equal to 5⅗ per cent. The total expenditure per ton has been 12*s*.; in the preceding year it was 16*s*. The expenditure this year includes a considerable sum incurred in

additions and permanent improvements, such as the melting-house and materials, large lathe and additions to the fitting shops, a small engine, and fitting up the Chilian mill. The profit on the quartz crushing for the year ending September 30 has been £22,958. 16*s*. 5*d*. The quantity of quartz stamped since the commencement of operations at Clunes has been 86,961 tons. In 1857 (six months), 4,146 to s; 1858 (twelve months), 13,321 tons; 1859, 17,542 tons; 1860, 21,694 tons; and in 1861, 32,258 tons. The machinery during the year has worked very satisfactorily. The Clunes Mine has during the year been worked energetically; the north shaft is about being sunk deeper, and the mine more extensively opened out. In consequence of its having been stated that an improved process for the treatment of auriferous ores had been devised at Freyberg, in Saxony, and was in operation at a mine in the extreme south of the Prussian territory, two of the members of the board, Mr. Macdonnell and Captain Vetch, accompanied by a gentleman conversant with the German language, proceeded there in August last. Their journey occupied upwards of six weeks; they obtained all the information in their power on the subject, both at Freyberg and at the mine in question. They afterwards proceeded to Vienna, where they obtained from the able and experienced secretary of the Aulic Council of Mines, Mr. Hocheder, information as to the treatment of the like mineral in the mines belonging to the Austrian dominions. The whole of the information so obtained, together with accounts of the treatment pursued at the company's establishment at Clunes, have been placed in the hands of Dr. Percy, Professor of Metallurgy in the Government School of Mines in Jermyn-street, by whom the question is undergoing an elaborate investigation. Dr. Percy has required, in addition to the information in his hands, that a portion of the "tailings," or "refuse," remaining after the extraction of the gold, shall be brought from Clunes, which has been ordered to be done. In the meanwhile, there is ground for hoping that means will be found by this investigation for diminishing the loss now sustained in the extraction of gold.

The financial statements show that the company have an available balance of assets over liabilities in England, £11,993. 12*s*. 10*d*.; and at Melbourne, £1,314. 8*s*. 7*d*. The reserve fund amounts to £2,160. 7*s*. 11*d*. New Three per Cents. The balance standing at the credit of profit and loss is £24,780. 1*s* 9*d*., out of which the directors recommend the payment of a dividend of 1*s*. 6*d*. per share, payable on January 15th, 1862, forming, with the distribution of 1*s*. per share declared in July last, the fourth dividend, and being at the rate of 12½ per cent. per annum. The subjoined statement shows the position of the company :—

Balance standing at the credit of the capital account, being the amount of capital remaining after charging to the debit of the account the losses sustained in the first years of the company's existence, £30,777. 13*s*. 2*d*.; balance at credit of profit and loss, being the amount of undivided profit £24,780. 1*s*. 9*d*.; reserve fund £2,033. 1*s*.; total, £57,590. 15*s*. 11*d*. Clunes Mining Establishment, £35,000; materials shipped to Melbourne, not arrived at Clunes, £1,606. 1*s*. 11*d*.; land and buildings at Melbourne, £5,000; office furniture, £181. 4*s*. 9*d*.; cash at Melbourne, £1,314. 8*s*. 7*d*.; cash and bills in London, £12,830. 19*s*. 8*d*.; less to pay on account of fourth dividend, £375=£12,455. 19*s*. 8*d*.; new Three per Cent. Consols (£2,160. 7*s*. 11*d*.) £2,033. 1*s*.; total, £57,590. 15*s*. 11*d*.

At the second ordinary general meeting of the proprietors of the GREAT NORTHERN COPPER MINING COMPANY OF SOUTH AUSTRALIA, held at the London Tavern, Bishopsgate, January 20th,—Mr. G. H. Donaldson in the chair, the following report was read :—The directors have much pleasure in submitting to the shareholders at this the second annual general meeting a statement of accounts from Nov. 3, 1860, to Nov. 3, 1861. It will be seen that the total expenditure for the year amounted to £17,727. 4*s*.; and that the ore sold during that period (amounting to 205 tons) realised £4,801. 10*s*. In addition to the ore actually sold, the company have about 375 tons of ore shipped, which, at the average price of the sales already effected, may be expected to produce £8,700. A further quantity of 445 tons is now in course of transit from the mines to Port Augusta. Nearly the whole of this ore has been raised from one mine, while the expenditure has been incurred in opening up five or six mines, at considerable distances from each other. Several of these mines are now yielding rich ore, and we may confidently expect largely increased returns from them in the ensuing year. The directors are happy to say, hat the claim set up for an interest in the Nuccaleena Mine has been withdrawn, nd the lease duly vested in the company, so that all risk of litigation on the subject

is at an end. The monthly reports of Capt. J. B. Pascoe continue to testify in the strongest manner that the mineral properties acquired by this company are likely to become largely remunerative. From these reports it will have been observed that the various mines are being opened with energy. A steam-engine, with requisite machinery, has been purchased in the colony on reasonable terms, and is now in course of erection at the Nuccaleena Mine, for the purpose of raising and crushing the ore in increased quantities; and orders have been lately given for a portable steam-engine, which will be forwarded to the colony as soon as it is ready, in order to meet the probable requirements at one or other of the mines. Mining labour continues to be obtainable at reasonable rates, but your directors intend again to urge on the colonial government the propriety of sending additional miners to the colony, in order that the supply may be adequate to the increasing demand. Cartage continues ample, and our local committee have advised a considerable reduction in the rate hitherto paid. The surveyor-general of the colony has assured the local committee that a township shall be immediately established in the neighbourhood of the Nuccaleena Mine. This will tend greatly to reduce the cost of operations at the company's mines, while at the same time it adds to the comforts of the men employed.

The Chairman, in moving the adoption of the report and accounts, was happy he could congratulate the proprietors upon the position and prospects of the undertaking. He believed he was justified in saying that few undertakings could, after a period of about fifteen months, show such results achieved. Notwithstanding the causes which had militated against their progress, in that short interval there had been actually sold nearly £5,000 worth of ore and about £9,000 worth shipped. In addition to that there were about 445 tons in course of transit from the mine to the port of shipment, and according to the estimate by Capt. Pascoe, in his September report, the quantity of ore in sight at the Nuccaleena Mine was 1,500 tons, which he valued at £30,000. After deducting the amounts paid to Mr. Bonny, and between £5,000 and £6,000 incurred in providing plant and machinery, the total working expenses, both at home and in the colony, did not exceed £12,000. As to their future prospects, he could only say it was his opinion, and that of his colleagues, that the Great Northern Copper Mining Company would prove a valuable and an important undertaking. In reply to enquiries, the Chairman stated that there had been 205 tons sold, which realised £4,800; 375 tons had been shipped, the value of which was estimated at £8,700; and there were 445 tons in course of transit from the mines to the port of shipment. In addition to which there were 1,500 tons of ore in sight. He also states that at present the cost of cartage from the mines to the port of shipment was £5 per ton, but the local committee led them to believe there would be a considerable reduction in that respect. As to the freight, it cost about *7s. 6d.* per ton of ore from the port of shipment to England.

It was then unanimously resolved that the report of the directors and the statement of accounts be received and adopted, the directors consenting to receive £550 per annum for their services.

Metal Markets.

THE following weekly reports from Messrs. Dadelszen and North, metal brokers, Leadenhall Street, show the position of the market during the month. *January 8th.*—There is scarcely any business doing in metals; buyers are evidently waiting for definite advices from America, and sellers are encouraged in their demand for higher prices by the peaceable complexion of the news already received.

IRON.—Welsh bars in moderate demand at £5. *2s. 6d.* f.o.b. Wales, and £6 per ton here. Staffordshire iron without change. Scotch pig iron has fluctuated from time to time, closing buyers at *48s. 9d.*; cash m. n. warrants.

COPPER is dull. English raw is obtainable £5 per ton under official prices, and manufactured at ½*d.* per lb. Foreign neglected. Burra and Kapunda £102 to £103, nominally.

TIN quiet, but steady; small parcels of banca have changed hands at from £121 to £122. We quote straits £117. The Dutch market has further improved to 73½f.

TIN PLATES are in better demand since the prospect of a rupture between America and ourselves seems likely for the present at least to be averted.

LEAD.—There is but little doing, without any alteration in price.

SPELTER.—This article has partially recovered after its heavy decline; holders of cash parcels here asking £18. 5*s*. Hull parcels, £18. 2*s*. 6*d*., W. H. £18. 15*s*.

January 15*th*.—There has not been that amount of business in the metal trade this week which we had every reason to expect. Holders adhere firmly to previous quotations, but operators use the greatest caution, and consumers only buy for their immediate wants.

IRON.—No change has taken place in the position of either Welsh Bars or Staffordshire Iron. The demand is languid. Scotch Pig iron has been in buyer's favour, closing at 48*s*. 4½*d*. cash.

COPPER continues extremely dull. English manufactured and raw are to be had below official quotations. But few transactions have been reported in Foreign. We have sellers of Burra and Kapunda at £*103*; buyers to a limited extent at £102; Chili Slabs, £91 to £92.

TIN continues steady, but there is not much business doing. We quote Banca from £123 to £124, and Straits £120 to £121, according to time of payment. There is good demand for English at fixed prices; this is now relatively considerably under foreign.

TIN PLATES.—There is more enquiry and prices stiffening.

LEAD remains unaltered in value. English pig £20. 5*s*.

SPELTER.—Some little business has been done at £18. 5*s*. to £18. 10*s*. spot, and with a month's prompt, holders generally ask £18. 10*s*. Hull parcels from 2*s*. 6*d*. to 5*s*. under our quotations here.

January 22*nd*.—The general aspect of the metal market has not changed since our last report; dulness is the prevailing feature, and one can only hope that a gradual but steady improvement will take place before long.

COPPER.—Although English copper is still obtainable under official quotation and in slack demand, holders of foreign evince more firmness. Burra and Kapunda £103 to £104. Chili slab has been sold to some extent in Liverpool, at £91 to £91. 10*s*. for export. Nearly the whole stock of Baltimore and Lake Superior copper has been re-shipped to America, where prices are extraordinarily high; the advance in New York is from 18 to 27 cents.

TIN.—We have had a quiet tin market, but holders are very firm; some little business has been done in straits at £120. Banca nominally £123. The Dutch market is quiet at 73½f.; English unaltered.

TIN PLATES are decidedly better; first quality charcoal realize now 28*s*. in Liverpool, and coke according to quality from 22*s*. to 23*s*.

LEAD.—Since the government has removed the prohibition of the export of lead, some little business has been done and higher prices are now asked. Good English pig £20. 10*s*. up to £21; Spanish, 20*s*. In Liverpool business has been done in good English pig, £20. 5*s*.

SPELTER is quiet, but there are no pressing sellers in the market. We quote spot and in Hull £18. 5*s*.; forward, £18. 10*s*,; W.H., £18. 15*s*. A sale of 300 tons for March, April and May shipment was reported on Monday, at £18. 10*s*.

Metallic-Ore Markets.

TIN.—The standards for black tin are now reduced to

Refined	..	£111.
Common	..	£107.

Upon these prices, the *West Briton* remarks :—"This fall presses heavily on many of our tin mines, and very few of them will give any dividends under the present depression. Since the 1st of January, 1861, the standard has gone down £20, and the price of good common tin £12 to £14 per ton. The drop to a mine selling, as Carn Brea and some other tin mines, from 100 to 180 tons of tin in two months, will reduce their dividends £1,200 to £2,200 per two months, or about £7,000 to £13,000 per annum. There is not much hope of an improved price before our relations with America become more settled."

COPPER.—At the three Cornish sales we give this month, the average produce, price per ton and standard, have been as follows :—

	Produce.	*Price per Ton.*	*Standard.*
Jan. 2	7	£6 6 0	£128 1 0
„ 9	6¾	6 1 6	129 18 0
„ 23	5⅝	4 10 6	135 8 0

In our last number we pointed out the unmeaning nature of the imaginary average standard at present calculated, and the confusion which arises in endeavouring to arrive at any intelligible conclusion from it. In an extract we gave last month, from Dr. Percy's Metallurgy, the mode in which this imaginary standard is arrived at was clearly explained. In an extract we give this month, from the same work, our readers will be able to judge as to what are the real charges of returning copper from the ores, compared with the mythical charge upon the basis of which the standard is computed. If Sir W. Logan's formula can be taken as correct, we could easily establish a sliding scale of returning charges from which an approximating true standard might be computed. We shall be glad to have any suggestions on this subject.

In order to show the utter confusion to which the present system gives rise, we shall again point out the differences between the calculations of the *West Briton* and the *Mining Journal* as to how the price of ores have really gone :—

As to the sale of January 2nd, compared with that of the previous week, the *West Briton* states there was an advance of 17*s*., while according to the *Mining Journal* there was a decline of £1.

As to the sale of January 9th, they both agree as to there having been an advance of 18*s*.; but as to that of January 28th, the *Mining Journal* makes an advance of £1, while, according to the *West Briton*, there is a decline of the same amount. This, however, may be a clerical error in copying one from the other. Be this as it may, we think we have sufficiently shown how unmeaning and confusing the present system is.

LEAD.—Comparing the sales of the early part of the month with those of the same period of the former month, there appears another slight decline. In the latter part of the month, however, there seems to have been a rally, and, on the whole, lead ores seem to close this month at about the same rates as last month.

London Share-Market.

THROUGHOUT the month of December last, favourable anticipations were indulged in, relative to the pacific solution of the differences arising out of the *Trent* question, and numerous opinions were current, prophesying that an immediate and extensive demand for all kinds of metals would inevitably follow the realization of these most sanguine expectations, and that the mining market would thereby receive an impetus nearly equal to that which would naturally be experienced in the consols and railway markets. The events of the past month have, however, proved these conclusions to be delusive, and the large orders for metals which were then spoken of as certain, are yet in abeyance. It is therefore almost superfluous to add that the benefit derived by the mining market from the amicable adjustment of the difficulty, has been exceedingly partial in comparison with the hopeful views entertained at the close of 1861, and at the opening of 1862. From the great decrease in the exportation of copper, tin and lead, as shewn by the latest Government returns published, it is obvious that one of our great sources for the consumption of metals is still almost closed, and in all probability will remain so until the struggle which is now, unhappily, waging between the Northern and Southern States of America is brought to a termination; but there may be occasional spasmodic movements in regard to the demands for other continental markets, and this medium it is hoped will counteract the drawback of the American civil war, and eventually send forth the large and abundant orders, which are absolutely necessary for the purpose of restoring the metal market to its former state of activity and prosperity.

The continued ease observable in the money market, and the farther reduction in the Bank rate of discount to $2\frac{1}{2}$ per cent., have materially tended to inspire confidence in the commercial community, and have had a most beneficial effect upon the markets; a large amount of money having already been withdrawn from the joint-stock banks, in order that it may be employed in more lucrative channels, and good, steady, dividend paying mines have thus eagerly been sought after for investment, and, in many instances, higher prices established.

The standard for copper ruled slightly higher at the beginning of January; but, at the sale on Thursday last, it again receded a little.

An improvement has taken place in the price of lead, which is most favourable for the lead districts.

The standard for tin remains unaltered, although a rise is generally looked for in the next week or two.

The following may be taken as the epitome of the Share Market for the month of January. Any important alterations that may occur after writing this will be found in the closing quotations, corrected up to the latest moment.

The dividend mines chiefly before the public during the month, have been :—Devon Consols, South Caradon, East Caradon, Marke Valley, Cook's Kitchen, Herodsfoot, North Downs, Providence, South Frances, West Caradon, Clifford Amalgamated, Wheal Margaret,

Wheal Seton, Wheal Mary Ann, Wheal Basset, East Basset, West Basset, South Tolgus, West Seton, St. Ives Consols, Carn Brea, Tamar Consols, and Craddock Moor.

Of progressive mines, East Carn Brea, North Treskerby, Great Fortune, New Seton, North Robert, Sartridge, Stray Park, West Polmear, West Rose Down, Wheal Edward, Wheal Uny, Wheal Grenville, East Grenville, Wheal Moyle, Wheal Trelawney, Wheal Arthur, Grambler and St. Aubyn, Pendeen, Wheal Unity, Long Rake, North Roskear, Wheal Grylls, Treloweth, Rosewarne United, Rosewall Hill and Ransom United, Bryn Gwiog, Carn Camborne, East Russell, South Carn Brea, Wheal Union, East Devon and Lady Bertha, have been dealt in. Devon Great Consols have become gradually firmer, and are now quoted 380—90; but it is very seldom that any shares are offered for sale, the general orders at present are to buy. The mine is reported as looking very favourable for farther discoveries, the usual two-monthly dividend declared at the end of this month (January) was £8 per share. South Caradon, after receding to 310 sellers, owing to a pressure of shares upon the market, have recovered, and seem at the moment very firm, with more buyers than sellers, whilst the quotation has advanced to 325-35: the next dividend is now about due. East Caradon shares improved as the time for holding the meeting drew nigh, and reached 30 buyers. The lode in the 50 fm. level east at this period was worth £90 to £100 per fm.; and the 60 fm. level east worth £50 per fm. This level is about 45 fathoms behind the working in the 50 fm. level. The new lode was reported worth £30 per fm.; and the rise in back of 60 fm. level was worth £80. A dividend of 15*s.* per share was declared, leaving a credit balance of £1,516. 14*s.* 7*d.* The prices farther advanced to $30\frac{1}{4}$ buyers ex. div., but have since declined and fluctuated between $28\frac{1}{2}$ and 30; they close $29\frac{3}{4}$-30. Marke Valley rose to $10\frac{1}{4}$, with many orders to buy, but there was scarcely a share to be had on the market on the day of the meeting. The dividend expected was 5*s.*, and it was only at the last moment that the proprietors determined on declaring a dividend of 6*s.* per share, which caused a great demand for the shares, and transactions as high as $10\frac{5}{8}$ ex. div. took place; the price is now 10 to $\frac{1}{4}$. The mine is looking well.

Cook's Kitchen are tolerably steady, at about 29 buyers; the dividend was 7*s.* per share, with a balance of £84. 7*s.* 4*d.* to credit of next account. Herodsfoot, after remaining rather quiet and dull at 37, have now improved to $38\frac{1}{2}$-$9\frac{1}{2}$: the dividend is due early in February. North Downs opened at $4\frac{1}{2}$-$\frac{3}{4}$, and suddenly became in demand, and rose to $5\frac{1}{4}$ buyers. The drivage is resumed at the 60 fathom level, where an improvement is expected. The winze sinking below the 50 fathom level west is worth £30 for 6 feet; this is 15 fathoms in advance of the 60 end. Providence decidedly firmer, and in some request at present quotations 43-5. South Frances, after touching 115 buyers, have become a trifle weaker, owing to a predominance of sellers. West Caradon flat at 45-47.

Wheal Clifford Amalgamated slightly firmer at 29-31. The next meeting will be due in February, when it is expected the accounts will shew a credit balance of £2,500. Wheal Margaret shares have

been in request at higher prices, 44-6. Wheal Setons have been more free from the violent fluctuations which have marked them during the past two months; they close steady at 120-122. Wheal Mary Ann, steady and quiet at 16-17. Wheal Basset shares scarce; many enquirers, but very few shares offering; price $92\frac{1}{2}$-$7\frac{1}{2}$. In East Basset very few transactions have to be recorded during the month; they remain stationary at 50-$52\frac{1}{2}$. This mine has some good chances of meeting with an improvement in a short time. West Basset inactive at 13-14.

South Tolgus have been frequently dealt in and close 54-6. West Setons much sought after, but no shares offering at fair market prices. St. Ives Consols occasionally inquired for at 26-27.

Carn Brea more in demand and close 70-75. Craddock Moor shares very scarce; at the 62 fathom level it is expected that Gilpin's lode will be intersected in a short time; price now 25-27. Tamar Consols became in demand owing to an improvement in the 237 fathom level, and rose to $2\frac{1}{2}$; they close, however, weaker—$1\frac{3}{4}$-2. East Carn Brea shares have shown great fluctuation during the month, having been as high as $11\frac{1}{4}$, and as low as $10\frac{1}{8}$: they close rather firm at $10\frac{1}{2}$-$\frac{3}{4}$. North Treskerby considerably improved, having advanced from 18 to 28 on the discovery of a lode in the shaft worth £70 for 12 feet in length. Great Fortune shares have been eagerly bought up, owing to the more promising position of the Company; they close $13\frac{1}{2}$-14 : a dividend of 10*s.* per share was declared at the meeting. New Seton many buyers, but no shares on the market at present; mine looking well.

North Robert rather in request at 18*s.*-19*s.* Sortridge 9*s.* 6*d.*-10*s.* 6*d.*, sellers predominating. Stray Parks very steady for some time at 30-31, with a little business doing; they close weaker. West Polmear have changed hands as low as 5*s.* At the West Rose Down meeting a call of £1 per share was made; since this there has been a great demand for the shares at advanced prices—13-15, Wheal Edward not very much inquiry at 2-$\frac{1}{4}$.

In Wheal Uny a large amount of business has been done; the ends, as well as north lode, are looking very promising; the shares are now steady at $5\frac{1}{2}$-6. Wheal Grenville and East Grenville very flat; the latter have been sold as low as 26*s.* Wheal Trelawney is reported to be looking better; the shares are steady at 16-$\frac{1}{2}$. Wheal Arthur 14*s.*, 16*s.*, steady. Grambler and St. Aubyn again enquired for at 16-18. Pendeen, not many transactions. Wheal Unity 14*s.* to 16*s.*; the lode in the 85 has improved.

Longrake 13-15; the mine is looking well. North Roskear advanced to 26-28, but again receded, and closed 22-24. Wheal Grylls $13\frac{1}{2}$-$14\frac{1}{2}$; shares have changed hands at $13\frac{7}{8}$. Treloweth looking firmer; now quoted $1\frac{1}{4}$-$\frac{1}{2}$. Rosewarne United nominally quoted 16-17. Rosewall Hill and Ransom United have been largely dealt in, and improved to $3\frac{1}{4}$-$\frac{3}{4}$. Bryn Gwiog $26\frac{1}{2}$-$7\frac{1}{2}$; at the last meeting there was £268. 18*s.* 2*d.* in favour of the mine. Carn Camborne have been in request for the last few days at 11*s.*, 13*s.* East Russell very inactive at $2\frac{1}{2}$-3. South Carn Brea very little business doing. Wheal Union in request at $2\frac{1}{4}$-$\frac{3}{4}$. East Devon steady at $1\frac{3}{4}$-2. Lady Bertha dull; a call of 2*s.* per share was made at the meeting.

In the Stock Exchange a very large and active business has been transacted in the Foreign markets; St. John Del Rey shares having again been in extraordinary request, and advanced from 50 to 65 during the month; they close 63-65.

United Mexican have also been dealt in to a considerable extent, and have remained comparatively steady in price; closing $8\frac{1}{4}$-$\frac{3}{4}$.

Scottish Australian in demand and risen to $1\frac{1}{2}$. Cobre Copper steady at 34-36. Dun Mountain remain firmer at 1-$\frac{1}{8}$. Great Northern Copper weaker, par to $\frac{1}{4}$ premium. East Del Rey firmer at $1\frac{3}{4}$. Kapunda not much dealt in, 2-$2\frac{1}{4}$. Linares, quiet and steady at $7\frac{3}{4}$-$8\frac{1}{4}$. Port Phillip, 1-$\frac{1}{8}$, $\frac{3}{8}$, ex dividend of 1*s.* 6*d.* per share. Bon Accord, business done at $\frac{5}{8}$. Copiapo 6-7, with occasional dealings. Worthing, General Mines, North Rhine, Pontgibaud Silver Lead, Lusitanian and others, dull, with scarcely any enquiries.

Monday, 27th January, 1862. 4 P.M.

The following are the closing prices furnished by Webb and Geach, of the Stock Exchange, London:—

Markets generally active, with more buyers. East Basset, Wheal Basset, and North Basset in good request; North Treskerby rather flat; sellers of Clifford; Providence flatter; Carn Camborne firmer; buyers of South Caradon; South Tolgus, East Caradon, and Marke Valley dull; Wendron Consols and West Rose Down in request.

BRITISH.

Alfred Consols, $\frac{1}{2}$ to $\frac{3}{4}$; Bryn Gwiog, 27 to 28; Camborne Vean, $1\frac{3}{8}$ to $\frac{5}{8}$; Carn Camborne, 12/. to 14/.; Copper Hill, 100 to 110; Cook's Kitchen, 29 to $\frac{1}{2}$; East Devon, $1\frac{3}{4}$ to 2: East Basset, 51 to 53; East Caradon, $29\frac{1}{2}$ to 30; East Carn Brea, $10\frac{3}{4}$ to 11; East Grenville, 26 to 28; Grambler and St. Aubyn, 16 to 18; Great Wheal Fortune, 13 to 14; Great Wheal Vor, $5\frac{3}{4}$ to $6\frac{1}{4}$; Herodsfoot, $38\frac{1}{2}$ to $9\frac{1}{2}$; Hingston Down, $2\frac{5}{8}$ to $\frac{7}{8}$; Billins, 18 to 20; Longrake, 13 to 14; Marke Valley, 10 to $\frac{1}{2}$; New Seton, 60 to 65; North Downs, $5\frac{1}{8}$; North Robert, 17 to 19; North Basset, $3\frac{1}{8}$ to $\frac{3}{8}$; North Roskear, 23 to 25; North Treskerby, 25 to 26; North Minera, 15/. to 17/6; Providence Mines, 43 to 45; Rosewall Hill, 3 to $\frac{1}{2}$; Sortridge Consols 10/. to 11/.; South Phœnix, 10/. to 12/6; South Caradon, 320 to 330; South Frances, 110 to 115; South Tolgus, 54 to 56; Stray Park, 30 to 31; Tincryft, $7\frac{7}{8}$ to $8\frac{1}{8}$; Treloweth, $1\frac{3}{8}$ to $\frac{5}{8}$; Wendron Consols, 11 to 12; West Rose Down, 13 to 15; West Seton, 280 to 90; West Polmear, 3/. to 5/.; Wheal Basset, 90 to 95; Wheal Clifford, $28\frac{1}{2}$ to $29\frac{1}{2}$; Wheal Grenville, 30/. to 35/.; Wheal Ludcott, $2\frac{1}{4}$ to $\frac{1}{2}$; Wheal Margaret, 43 to 45; Wheal Mary Ann, 16 to 17; Wheal Seton, 122 to 24; Wheal Trelawney, $18\frac{1}{2}$ to $19\frac{1}{2}$; Wheal Uny, $5\frac{3}{4}$ to 6.

FOREIGN.

Bon Aecord, $\frac{1}{2}$ to $\frac{5}{8}$; Copiago, 6 to 7; Dun Mountain, par. to $\frac{1}{8}$ pm.; East Del Rey, $1\frac{1}{2}$ to $\frac{3}{4}$; Great Northern Copper, $1\frac{1}{8}$ to $\frac{1}{4}$; Port Phillip, $1\frac{1}{8}$ to $\frac{1}{4}$; Cobre Copper, 34 to 36; St. John del Rey, 64 to 66; Scottish Australian, $1\frac{3}{8}$ to $\frac{1}{2}$; United Mexican, $8\frac{1}{2}$ to $\frac{3}{4}$.

Provincial Share Markets.

DUBLIN.—The following report is condensed from the *Mining Journal*:—In the early part of the month Wicklow Copper shares were freely taken at £53. 15*s*. Of speculative mines, General Mining Company for Ireland were most in favour, but could not command more than £5. 7*s*. 6*d*. per share. Connoree shares 31*s*. 6*d*. and 32*s*. Carysfort shares not in request. Further on in the month Wicklow Copper Mining Company shares advanced to £57, or a rise of £3. 5*s*. for the week—buyers; sellers looking for £57. 10*s*. In consequence of the favourable report issued by the Mining Company of Ireland of the prospects of their mines, and the state of their affairs generally, their shares made a smart upward move, and for two or three days were bought at £16, and £16. 5*s*., or an advance of 7*s*. 6*d*. A slight reaction then took place, prices receding to £15. 17*s*. 6*d*. General Mining Company for Ireland shares weak at £5. 7*s*. 6*d*. For Carysforts 4*s*. 6*d*. per share was offered, but no noticeable transactions took place. Connorree shares touched 33*s*. and receded to 32*s*., or a premium of 60 per cent. on 20*s*. paid up, demonstrating how much quotations of mine shares can be influenced by the capability of owners to hold out for a certain price, whether warranted or not by the prospects of the undertaking.

Still later, the quotations of Wicklow Copper shares were scarcely sustained, there being fewer purchasers. The Mining Company of Ireland shares were still quoted at £16. 5*s*.; but this being now marked ex-div., *it* is equal to £16. 13*s*. 9*d*. with dividend, or to a rise of 8*s*. 9*d*. per share on former prices. General Mining Company for Ireland shares showed weakness at last rates. Carysfort shares changed hands at 8*s*. 6*d*., sellers at 9*s*. Connorree shares are flat at 33*s*. Towards the end of the month, Wicklow Copper shares dropped from £56 to £53. 10*s*.; and Mining Company of Ireland shares went down to £15. 12*s*. 6*d*., sellers in both. On receipt of intelligence from London of an improvement in English funds, mine securities recovered somewhat from their depression, and Wicklow Copper shares were freely taken at £54. 7*s*. 6*d*., as have also Mining Company of Ireland shares at £16, ex. div. General Mining Company for Ireland shares are nominally £5. 5*s*. The quotation of Connorree shares continues at 33*s*. 6*d*., but no *bonâ fide* purchases have transpired; fresh investors would scarcely go beyond 20*s*. per share, or par. The revived attention to Carysfort shares somewhat subdued, for having been in demand at 8*s*. 6*d*. they were offered at 8*s*. each.

MINING REVIEWS.

The Progress of Mining in 1861; *being the Eighteenth Annual Review*, By JOSEPH YELLOLY WATSON, F.G.S. London: Published at the Mining Journal Office, 26, Fleet Street.

THAT Mr. Watson's Review has reached its eighteenth annual publication is the best possible evidence of the appreciation in which it is held by the mine-speculating public. As the head of a well-known and influential mine-broking firm, no one connected with the London market is in a better position to acquire accurate information, and to form correct judgments—leaving out of the question the facilities he possesses as City editor of an influential journal. Availing himself of all these advantages, and of a wide mining connection, Mr. Watson compiles annually a mass of information respecting all the mines possessing interest for market speculators, which does infinite credit to his industry and judgment.

From his position it is of course natural that Mr. Watson should look at mines principally in their market aspects, and dwell upon many intrinsi-

cally insignificant, but possessing an interest from being made a medium of speculation in the share-world. Not that by any means Mr. Watson confines his reviews to mere market concerns, for he includes, and gives valuable information upon, many which are rarely or never dealt in; and on the whole his Review gives the best body of information on the commercial position of Cornish, Devon, and Welsh Metallic Mining, in a compact compass, accessible to the public.

A Brief Review of the British and Foreign Mining Market for the Year 1861, *with Prices, Dividends, Ore Sales, &c., &c.* By Webb and Geach, of the Stock Exchange, and 8, Finch Lane, London.

Messrs. Webb and Geach have, in this Review, succeeded in giving us one of the most valuable contributions yet made to our knowledge of the market progress of mining affairs. Among the mass of publications issued by those connected with the London mining share-market, it is certainly remarkable that none have hitherto given us an Annual Review of the Market itself—a work which, above all others, they were capable of doing efficiently. Instead of doing so, they have given us contributions in abundance about mines, mining, and even the geology of mineral veins; upon subjects, in fact, upon which they were but indifferently acquainted, and respecting which they not unfrequently made the most palpable blunders.

Messrs. Webb and Geach, it seems to us, have taken the ground which, as brokers and members of the Stock Exchange, was the proper one to take. They do not write about mining, its technicalities, or its geology, upon which subjects their acquaintance must necessarily be limited; but give us a review of what they are masters of—that is, the market. Of this they give a series of monthly reviews—similar to that supplied in our pages—which together form a history of market progress which is not to be found in any other quarter. The statistics, too, are compiled with great care, and will be found invaluable for ready reference. We do not know where else they can be found in the same space.

Prices Current of Metals.

			Per	Ton.	
IRON	Bars	in Wales	£5 2 6	@	£5 5 0
	„	„ Liverpool	......		5 15 0
	„	„ London	6 0 0	„	6 5 0
	Nail Rods	„ Wales	5 12 6	„	5 15 0
	„	„ Liverpool	6 10 0	„	7 5 0
	„	„ London	7 5 0	„	7 15 0
	Hoops (Staffordshire)	„ Liverpool	7 15 0	„	8 10 0
	„ „	„ London	8 5 0	„	8 15 0
	Sheets „	„ Liverpool	8 10 0	„	9 5 0
	„ „	„ London	9 0 0	„	9 15 0
	Bars „	„ Liverpool	7 0 0	„	8 0 0
	„ „	„ London	7 10 0	„	8 10 0
	Scotch Pig (No.1.g.m.b.)	the Clyde	2 8 6	„	2 9 0
	Rails	in Wales.	5 0 0	„	5 5 0
	Russian	C.C.N.D	......	„	......
	Swedish—Hammered—large sizes.		11 10 0	„	11 15 0
	„ „ Indian sizes		11 10 0	„	11 15 0
STEEL	Hammered—faggot		......		16 10 0
	„ in kegs ½ and ⅝ in.		......		15 10 0
COPPER	Australian and other *fine* Foreign		102 0 0	„	103 0 0
	Foreign Slab, for Prod. 96 per Cent.		91 0 0	„	91 10 0
	English Tile and Tough		103 0 0	„	107 10 0
	„ Best selected		105 10 0	„	110 10 0
			Per	lb.	
	„ Sheets, Sheathing and Rod		11½*d.*	„	12*d.*
	„ Flat Bottoms		12*d.*	„	12½*d.*
YELLOW METAL	Sheets, Sheathing and Rod		9*d.*	„	10*d.*
			Per	Cwt.	
TIN English	Common Blocks and Ingots		......		120*s.*
	„ Bars (in barrels)		......		121*s.*
	Refined		......		122*s.*
Foreign	Straits		119*s.*	„	120*s.*
	Banca		123*s.*		124*s.*
			Per	Box.	
TIN PLATES at Liverpool 6d. Less.	Charcoal IC		28*s.*	„	29*s.*
	„ IX		34*s.*	„	35*s.*
	Coke IC		22*s.*6*d.*	„	23*s.*
	„ IX		28*s.*6*d.*	„	29*s.*
			Per	Ton.	
LEAD	Sheet		21 0 0	„	21 5 0
	Pig—W.B.		......		21 10 0
	„ ordinary brands		20 10 0	„	20 15 0
	„ Foreign, soft		19 10 0	„	19 15 0
	Red		......		21 10 0
	Shot		......		23 0 0
	Dry White		......		27 0 0
SPELTER	(Cake)		£18 5 0	„	18 10 0
ZINC	(Sheet)		23 10 0	„	24 0 0
			Per	Bottle.	
QUICKSILVER	(in bottles containing 75 lbs. each)		......		7 0 0
			Per	Ton.	
REGULUS OF ANTIMONY, French Star			......		47 0 0

The transactions in Metals during the last week have been for the most part unimportant.

IRON.—*Scotch Pig* is easier; other sorts unchanged.

COPPER.—A slight reduction to note in *fine Foreign*; in *Chili Slab* business has been done at £91 to £91 10*s.* *English* without alteration, and demand slack.

TIN.—Rather more inquiry, and several parcels of *Straits* have been purchased at 119*s.* to 120*s.*, according to quality and prompt.

LEAD.—The permission to export has operated beneficially on this metal, and quotations show an advance of 10*s.* to 15*s.* per ton. The trade have purchased rather largely in the North, at £19 10*s.* to £20 for *Common*, and £22 for *Refined* Pig, usual terms.

SPELTER continues dull, and only sales of spring shipment are reported (250 tons), at £18 10*s.* per ton.

Copper Ores,

Sampled Dec. 18, and sold at Tabb's Hotel, Redruth, Jan. 2.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	109	9	£5 3 6
(Wheal Clifford)	107	10	4 17 6
	105	4	5 2 0
	100	8	5 6 0
	88	4	7 16 6
	74	4	7 0 0
	68	11	5 1 0
	59	4	6 10 0
	28	6	15 15 6
	22	11	3 13 0
West Seton..................	94	8	8 8 0
	59	8	8 5 6
	56	11	2 15 0
	55	11	2 15 0
	52	8	8 8 0
	46	8	7 18 0
	44	3, 11	4 13 0
	43	4, 7	7 11 0
North Roskear (Enys)	64	3	9 15 0
	53	2, 4	12 6 6
	24	3	2 16 0
(Basset)	40	4	4 6 6
(Pendarves)	37	4	3 8 6
	33	4	6 3 0
South Tolgus	74	7	5 6 6
	71	7	8 13 6
	58	7	4 7 6
	47	7	13 15 6
Wheal Basset	82	2	5 13 6
	75	2	5 17 0
	45	2, 6	11 15 6
Wheal Basset	30	2, 6	£12 6 0
South Frances	57	6	6 1 0
	49	6	5 6 0
	44	6	9 9 0
	36	7, 8	5 6 6
	15	6	2 2 0
Wheal Seton'...............	9	7	5 4 0
(Pendarves)	65	7	6 9 0
	47	7	6 17 0
	38	3	4 15 0
	20	3	12 19 6
East Pool	60	10	4 15 0
	52	11	4 17 0
East Bassett	47	6	4 17 0
	30	8, 9	4 11 0
	26	10	9 3 6
Tolcarne	53	9, 11, 14	2 18 6
	37	11	5 17 6
North Crofty...............	43	8	4 12 6
	37	8	7 18 6
West Stray Park.........	56	6	7 17 0
Tresavean	55	8	1 19 6
Jackson's Ore	55	2	0 2 6
Wheal Uny..................	33	11	2 8 0
	16	10	7 10 0
Crane	28	8	7 16 0
Halse's Ore	9	2	0 0 6
	8	2	0 0 6
Wheal Harriett...........	12	8	6 8 6
Wheal Kitty	9	6	8 14 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amalgamated.........	760	4,606 14 0
West Wheal Seton...............	449	2,912 10 6
North Roskear	251	1,847 2 0
South Wheal Tolgus............	250	1,911 3 0
Wheal Basset......................	232	1,802 19 6
South Wheal Frances.........	201	1,243 11 0
Wheal Seton	179	1,228 0 0
East Pool............................	112	537 4 0
East Wheal Basset	103	603 0 0
Tolcarne	90	372 8 0
North Crofty	80	492 2 0
West Stray Park...............	56	439 12 0
Tresavean	55	108 12 6
Jackson's Ore....................	55	6 17 6
Wheal Uny	49	199 4 0
Crane	28	218 8 0
Halse's Ore........................	17	0 8 6
Wheal Harriett	12	77 2 0
Wheal Kitty	9	78 10 6

EACH COMPANY'S PURCHASE.

	Tons.	£	s.	d.
1 Mines Royal Co............	—	——		
2 Vivian and Sons............	298	1,687	9	0
3 Freeman and Co............	168	1,233	10	0
4 Pascoe Grenfell and Sons	484	8,117	4	3
5 Crown Copper Co.........	—	——		
6 Sims, Willyams and Co..	342⅛	2,689	1	3
7 Williams, Foster and Co.	410⅝	2,957	6	6
8 Mason and Elkington...	559	3,668	7	0
9 F. Bankart & Sons........	141⅜	684	0	6
10 Copper Miners' Co.........	209	1,165	3	6
11 C. Lambert.................	362⅜	1,431	14	0
12 Newton, Keates & Co.....	—	——		
13 Alkali Co.....................	—	——		
14 Sweetland Tuttle and Co	17⅜	51	13	6
	2,988	£18,685	9	0

Average produce, 7.
Quantity of fine Copper, 210 tons 2 cwt.

Average standard, £128 1s. 0d.
Average price per ton £6 6s. 0d.

Copper Ores,

Sampled Dec. 26, and sold at Tabb's Hotel, Redruth, Jan. 9.

Mines.	Tons.	Purchasers.	Price. £	s.	d.
West Basset	75	11	£4	18	0
	69	8	4	10	6
	64	10	4	8	0
	63	10	10	10	0
	62	1, 8	6	1	0
	59	10	7	6	6
	34	11	4	17	6
	30	8	9	15	6
	24	6,8,10	9	1	0
Carn Brea	75	10	4	6	0
	74	10	3	0	0
	67	4	10	7	6
	62	10	8	19	0
	59	10	3	5	0
	8	10	4	14	0
Alfred Consols	77	2	3	15	0
	59	2	1	10	0
	58	2	3	17	6
	56	2	12	6	0
	36	2	11	5	6
Par Consols	80	3,7	8	8	6
	76	4	10	2	6
	73	10	8	0	6
	34	4	3	16	0
	1	9	53	10	6
Wheal Margery	63	5,7	8	6	6
	55	6	3	14	6
	54	5,7	2	18	6
	51	7	2	14	6
	9	6	7	0	0
Tolvadden	52	14	3	4	6
	51	9	3	10	6
Tolvadden	47	3,8,11	7	8	6
	31	11	3	17	0
	5	8	20	3	0
Copper Hill	69	6	2	8	0
	43	8	7	2	6
	19	6	5	2	6
North Basset	42	5,7	4	12	6
	36	8	3	17	6
	29	8	6	15	0
Wheal Buller	66	3	3	12	6
	40	6	11	11	6
Wheal Agar	46	3	8	5	0
	26	5,7	6	7	6
	25	3	10	16	0
Wheal Alfred Consols	40	3,11	1	7	0
	20	9	4	12	0
	12	8	1	7	0
	11	3,8	1	12	0
	9	11	1	7	6
East Rosewarne	33	7	5	16	6
	27	7	9	1	6
	22	7	13	14	6
South Crenver	53	6	2	10	0
	9	6	8	4	0
West Trevelyan	24	6	7	6	0
	12	6	0	7	0
Treffry's Regulus	21	2,6	15	18	0
Clijan and Wentworth	17	8	2	18	6
Rosewarne Consols	10	3	8	19	0
	5	4	18	8	0
Wheal Union	13	8	4	5	0
Providence Mines	10	6	8	1	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount. £	s.	d.
West Basset	480	£3,106	6	0
East Carn Brea	345	2,023	17	6
Alfred Consols	286	1,696	14	0
Par Consols	264	2,212	1	0
Wheal Margery	232	1,089	5	6
Tolvadden	186	916	11	0
Copper Hill	131	569	7	0
North Basset	107	529	10	0
Wheal Buller	106	702	5	0
Wheal Agar	97	815	5	0
West Alfred Consols	92	192	3	6
East Rosewarne	82	739	4	0
South Crenver	62	206	6	0
West Trevelyan	36	179	8	0
Treffry's Regulus	21	333	18	0
Clijah and Wentworth	17	49	14	6
Rosewarne Consols	15	181	10	0
Wheal Union	13	55	5	0
Providence Mines	10	80	10	0

EACH COMPANY'S PURCHASE.

		Tons.	Amount. £	s.	d.
1	Mines Royal	—	—		
2	Vivian and Sons	296½	1,863	13	0
3	Freeman and Co.	228 3½	1,467	7	6
4	Grenfell and Sons	182	1,685	16	6
5	Crown Copper Company	92½	521	4	3
6	Sims, Willyams and Co.	349½	1,886	19	0
7	Williams, Foster & Co.	265½	1,736	7	9
8	Mason and Elkington	314 3½	1,854	2	0
9	F. Bankart & Sons	72	325	6	0
10	Copper Miners' Compy.	545	3,362	5	0
11	Charles Lambert	184½	808	6	0
12	Newton, Keates and Co.	—	—		
13	Alkali Company	—	—		
14	Sweetland and Co.	52	167	14	0
		3073	£15,679	1	0

Average produce, 6¾.
Quantity of fine Copper, 175 tons 7 cwts.

Average standard, £129 18s. 0d.
Average price per ton, £6 1s. 6d.

No Sale January 16th.

Copper Ores,

Sampled Jan. 8, and sold at the Royal Hotel, Truro, Jan. 23.

Mines	Tons.	Purchasers.	Price.
Devon Great Consols...	119	11	£4 6 0
	115	5,7	3 19 6
	113	10	4 5 0
	110	3	3 14 0
	107	11	1 17 6
	103	7	3 0 6
	98	7,11	3 7 6
	95	3	5 9 0
	91	2	8 7 6
	89	11	1 15 0
	88	5,7	9 10 6
	84	5,7	3 14 6
	81	14	3 6 6
	78	5,7	3 14 6
	76	11	1 4 6
	67	11	3 6 0
	66	7	3 1 6
	65	3,11	1 19 6
	64	3,11	2 12 6
	57	7	4 14 0
	51	11	1 7 6
	50	8	8 8 0
	43	11	3 8 0
	41	11	3 4 0
	40	14	4 10 0
	39	7,8	4 19 0
	35	14	2 19 6
East Caradon	91	10	5 2 0
	82	6	10 14 0
	70	11	4 9 0
	68	6,10	8 10 6
	64	8	4 6 6
Hingston Down	85	4	5 6 0
	80	4	3 3 0
	70	4,7,10	3 8 6
	67	4	7 7 6
	41	7	3 3 6
Marke Valley	89	3	4 7 0
	88	2,7	4 1 6
	65	2,7	4 4 6
Marke Valley	61	7	£4 14 6
	57	7	4 19 6
Holmbush	109	6	2 3 6
	74	4	5 17 0
	73	6,8	13 10 6
	66	4	5 0 6
Lady Bertha	101	8	2 19 6
	85	8	2 19 6
	74	8	3 4 6
Bedford United............	108	8,10,11	4 8 0
	101	7	5 16 6
East Russell	84	14	4 6 6
	68	4	6 2 0
	44	4	6 7 0
	5	4	18 15 0
Gunnis Lake (Clitters) .	78	5,7	5 6 0
	61	9,14	4 19 6
	53	9	4 15 6
Wheal Friendship	98	11	3 13 6
	58	2,7	11 6 6
Kelley Bray	80	8	3 18 6
	46	3	1 5 0
	20	10	5 11 6
Wheal Emma	55	7,11	4 4 0
	52	7	8 15 0
	33	11	2 7 0
Great Wheal Martha ...	76	2,6	2 12 0
	52	2,6	1 14 6
Okel Tor......................	68	2,3	2 14 6
	30	7	4 18 0
Wheal Crebor......	85	14	3 17 6
Molland	50	5,7	5 10 6
Brookwood	48	10	4 18 0
	2	10	19 10 0
Fursdon	20	14	2 5 6
	19	2	5 15 6
Hawkmoor..................	17	6	4 17 6
	13	11	4 9 6
Gawton	27	3	3 10 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2065	£8175 15 0
East Caradon..................	375	2509 10 0
Hingston Down	363	1630 1 0
Marke Valley	360	1592 3 6
Holmbush	322	1988 19 0
Lady Bertha.....................	260	792 0 0
Bedford United................	209	1063 10 6
East Rusell	201	1151 5 0
Gunnis Lake (Clitters)......	192	969 19 0
Wheal Friendship............	156	1017 0 0
Kelley Bray......................	146	£ 483 0 0
Wheal Emma....................	140	763 11 0
Great Wheal Martha.........	128	287 6 0
Okel Tor	98	332 6 0
Wheal Crebor	85	329 7 6
Molland............................	50	276 5 0
Brookwood	50	274 4 0
Fursdon	39	155 4 6
Hawkmoor	30	141 1 0
Gawton	27	94 10 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Mines Royal	—	£ ——
2 Vivian and Sons.............	313¼	1753 3 9
3 Freeman and Co.............	465½	1704 14 9
4 Grenfell and Sons...........	512½	2829 0 10
5 Crown Copper Co...........	246¾	1294 4 3
6 Sims, Willyams & Co.......	342½	2124 10 3
7 Williams, Foster & Co....	1059½	5134 15 10
8 Mason and Elkington....	546	£2551 7 9
9 F. Bankart..................	83¼	404 16 3
10 Copper Miners' Co........	367½	1858 4 4
11 Charles Lambert...........	984	2924 12 9
12 Newton, Keates & Co....	—	——
13 Alkali Co. (Limited)......	—	——
14 Sweetland and Co.........	375½	1443 7 3
Total...........	5296	£24,022 18 0

Average Produce, 5¾.
Quantity of Fine Copper, 285 tons 0 cwts.

Average Standard, £135 8 0.
Average Price per ton, £4 10 6.

We cannot include the last Cornish sale of the month, as it does not take place until our day of publication, the 30th instant.

Copper Ores,

Sampled Dec. 18, and sold at Swansea, Jan. 7.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	96	12½	7	£11 9 0	Cobre.............	50	21½	3	£19 16 0
	95	12¾	7	11 13 0		48	21½	16	20 0 0
	86	12½	7	11 12 6		10	57½	5	50 7 0
	69	12¾	2,3,6,7	11 15 0	Wheal Maria ...	57	34¼	1,10	32 5 6
	60	22¼	5	20 0 6		40	21¼	2	19 19 0
	59	22⅛	3	20 1 0		36	24¾	1	23 2 6
	58	22½	5	20 6 6	Ookip	44	34½	3	32 5 0
	5	15½	3	14 5 0	Union Ore	68	7	8	6 5 0
	12	57¾	5	53 0 0		63	7⅞	12	6 19 6
	92	12	7	11 7 6	(Precipitate) ...	27	69½	5	61 7 6
	91	11¾	6	11 8 0		27	69½	5	59 13 0
	90	11¾	3,6	11 8 0	Holyford.........	5	9¾	2	8 13 0
	89	12	6	11 2 0		1	8⅝	2	7 10 0
	75	12¼	6	11 3 0	Spanish.........	5	12⅛	16	11 0 6
	74	11¾	3	11 2 0		1	20	1	18 3 6
	51	21½	2,3,7	19 17 0	Copper dross...	1	29½	3	25 0 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
Cobre..............................	1250	£17,508 6 0	Holyford	6	£50 15 0
Wheal Maria....................	133	3,470 3 6	Spanish............................	6	73 6 0
Ookip..............................	44	1,419 0 0	Copper dross....................	1	25 0 0
Union Ore.......................	185	4,132 1 6			

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Copper Miners' Comp...	65¼	£1,770 10 3	8 Mines Royal Company	68	£425 0 0
2 Freeman and Co.	80¼	1,388 17 9	10 Mason and Elkington ...	28¼	919 16 9
3 P. Grenfell and Sons ...	312¼	5,562 14 9	12 C. Lambert	63	439 8 0
5 Sims, Willyams and Co.	194	6,787 10 6	16 Jennings & Co.............	53	1,015 2 6
6 Vivian and Sons	317¼	3,577 4 9			
7 Williams, Foster & Co...	403¼	4,792 6 9		1,585	£26,678 12 0

Copper Ores,

Sampled January 1, and Sold at Swansea, January 21.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce.	Purchasers.	Price.
Cuba	100	12¼	3	£11 1 0	Cuba...............	8	63¾	5,6	£59 11 0
	95	12¼	7	11 2 0		7	72½	5	62 3 0
	90	12¼	7	10 19 6		6	71½	6	62 2 0
	87	12¼	3	11 0 6	Knockmahon..	94	14¼	7	13 3 0
	71	12	12	10 18 0		79	14½	2,3,7	13 3 0
	58	15⅞	1	13 18 0	Berehaven......	84	10⅝	12	9 6 0
	3	70½	5	58 12 0	Wheal Maria...	22	21⅜	1	19 13 0
	85	12⅛	2,7	10 18 6		11	21⅝	1	19 15 6
	80	12	1,7	10 15 6	Ookip	8	33¼	1,5	31 0 0
	70	12⅜	2,7	10 18 0	Turkish..........	15	14⅜	12	13 0 0
	74	19½	1,3	17 14 0	Tuscany.........	10	5⅞	16	4 0 6
	65	20⅜	1	17 18 6	New So. Wales	1	9⅛	16	8 5 6
	55	20½	3,5	18 2 0		1	9⅝	6	8 3 0
	38	20⅛	6	17 18 0					

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
Cobre	992	£13850 12 6	Ookip	8	£248 0 0
Knockmahon	173	2274 19 0	Turkish	15	195 0 0
Berehaven......................	84	783 6 0	Tuscany............................	10	40 5 0
Wheal Maria...................	33	649 16 6	New South Wales	2	16 8 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Copper Miners' Co.......	237	£3831 1 0	7 Williams, Foster & Co.	422 5-6	£4901 8 11
2 Freeman and Co.........	103 5-6	1192 1 11	12 Charles Lambert.........	170	1752 4 0
3 P. Grenfell and Sons...	277 5-6	3563 2 2	16 Jennings & Co............	11	48 10 6
5 Sims, Willyams & Co.	45¼	1470 16 0			
6 Vivian and Sons.........	49	1299 3 0	Total...........	1317	£18,058 7 6

Black Tin Sales.

Date.	Mines.	Tons c. q. lbs.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Dec. 21.	Garlidna	5 13 0 6	71 10 0	Bissoe	478 18 11
	,,	1 4 3 20	60 0 0	Ditto	
,, ,,	North Roskear	6 15 3 9	67 0 0	Mellanear	455 0 6
,, 28.	Drake Walls	3 10 0 0	70 12 6	Daubuz & Co.	1293 17 6
	,,	3 10 0 0	70 12 6	Bissoe Co	
	,,	6 0 0 0	66 12 6	Daubuz & Co.	
	,,	6 0 0 0	66 12 6	Bissoe Co	
Jan. 2.	Gurlyn	4 16 2 20	65 0 0	Chyandour	314 4 0
,, 12.	Wheal Kitty	4 11 2 15	62 10 0	Trethellan	559 18 11
,, 11.	,,	4 7 2 5	62 10 0	Ditto	
,, 10.	Penhalls	2 10 1 24	67 5 0	Trethellan	343 13 10
,, 11.	,,	2 11 3 0	67 5 0	Bissoe	
,, 14.	Great Wheal Vor	20 7 2 22	—	—	1477 12 3

Tin ores being sold by private contract, the particulars are not generally published or accessible. We hope, however, to be able to provide monthly a tolerably complete list of the sales of this metallic ore: the above list gives no idea of the real sales.

Sundry Copper Ore Sales.

Sold by Mr. James Lewis, at Liverpool, from Laxey Mine.

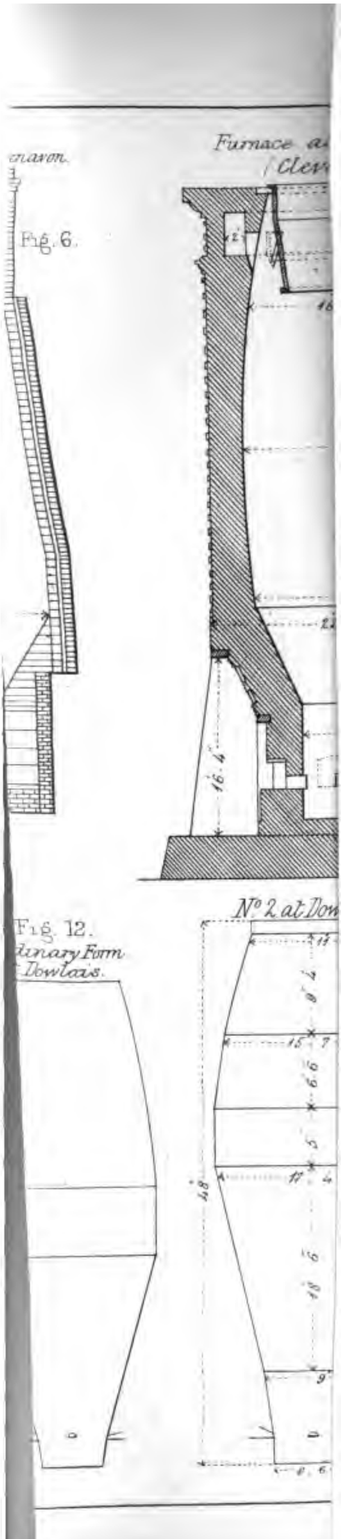
Date.		Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Jan. 3.	Lot 1 (ex *Jane & Agnes*)	62	4 8 0	Newton, Keates & Co	693 0 0
,, 9.	2 (ex *Ruby*)	38	4 15 6	Ditto	
	Sold at Liverpool, by Mr. J. Pitcairn Campbell.				
,, 21.	Lot 1 (*Reveral*)	30	3 14 6	C. Lambert	828 19 10½
	2 (*Coila*)	32	3 14 6	ditto	
	3 (ditto)	13	7 0 0	ditto	
	4 (*Lisette*)	30	3 10 0	ditto	
	5 (ditto)	5	7 1 9	J. Keys & Son	
	6 (*Chanarcello*)	5	24 11 6	Vivian & Sons	
	7 (ditto)	2½	29 15 0	ditto	
	8 (ditto)	4¼	28 14 6	ditto	
	9 (ditto)	1½	32 1 6	ditto	
	Sold by the Parys Mines Company.				
,, ,,	Lot 1	225	5 13 6	C. Lambert	1440 0 0
	2	75	2 15 6	ditto	

Blende Sales.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
Dec. 30.	Great Retallack	460	1 4 0	Vivian & Sons	552 0 0
,, 31.	Minera Mining Co.	80	2 0 0	Kenrick Wright Courage	729 14 0
	,,	80	2 5 0	Courage & Co.	
	,,	106	3 3 0	Vivian & Sons	
	,,	24	2 6 6	Courage & Co.	

Lead Ore Sales.

Dates.		Mines.	Tons.	Price per Ton	Purchasers.	Amou Mon £
Dec.	27.	Isle of Man Mining Co.'y.	100	14 0 0	—	1400
„	28.	Wheal Mary Ann	60	24 10 6	Stock & Co.	1471
„	31.	Minera	100	12 10 6	Walker, Parker & Co.	4823
		„	100	12 11 0	ditto	
		„	40	12 7 6	ditto	
		„	100	12 10 0	ditto	
		„	30	12 7 6	ditto	
		North Minera	20	11 16 0	ditto	236
Jan.	1.	Dyliffe	65	12 6 6	Newton, Keates and Co.	1607
		„	65	12 8 0	A. Eyton	
		Llanerchyraur	49	13 8 6	Walker, Parker and Co.	657
		Dyfngwm	55½	12 0 0	Newton, Keates and Co.	1082
		„	35½	11 18 0	ditto	
		Rhoswydol	18½	11 6 6	Walker, Parker & Co.	313
		„	9	11 11 0	ditto	
		Aberdovey	7¾	11 17 6	ditto	184
		„	7¾	11 17 6	Newton, Keates & Co.	
		Yralltwen	3¾	11 13 0	A. Eyton	43
„	3.	Exmouth	80	10 0 0	Stock and Co.	800
		Wheal Frank Mills	65	15 12 6	Treffry's Trustees	1641
		„	50	12 10 6	ditto	
		Penpompren	20	12 19 0	Sims, Willyams and Co.	259
„	6.	East Logylas	80	11 16 0	Panther Company	944
		Cwmystwith	120	12 0 0	ditto	1440
		Glogfach	65	15 10 0	Sims, Willyams and Co.	1007
„	7.	Llanfair	25	25 15 6	Treffry's Trustees	744
		Talargoch (Maesyrerwddu)	36½	12 16 6	Walker, Parker & Co.	962
		„ (Coetia Llys)	38	13 0 0	Newton, Keates & Co.	
		Deep Level	20	12 5 0	ditto	245
		Brynford Hall	5	12 0 0	A. Courage and Co.	60
		Herward United	10	11 3 6	Walker, Parker & Co.	111
		Rhosesmor	72	12 5 6	ditto	907
		Orsedd	11	12 8 6	ditto	136
		Parry's Mine	30	12 5 6	ditto	368
		Bryn Gwiog	30	12 13 0	A. Eyton	379
		Long Rake	15	12 11 0	ditto	188
		Pwllmelyn	4	8 1 0	Newton, Keates and Co.	32
		Holywell Level	10	13 13 6	A. Eyton	136
		Dylife	60	12 5 6	ditto	736
„	10.	Cargoll	63	14 2 6	R. Michell & Son	889
„	11.	Keswick	25	12 3 0	W. J. Cookson and Co.	303
„	20.	Frongoch	130	12 4 0	Sims, Willyams and Co.	1586
		Gwaith Coch	15	11 2 0	ditto	333 0
		„	15	11 2 0	Panther Company	
		East Darren	72	15 9 0	Sims, Willyams & Co.	1112 8
		Cwm Erfin	35	15 5 6	Treffy's Executors	834 12
		„	20	15 0 0	Panther Company	
„	23.	Westminster	50	12 1 0	Walker, Parker and Co.	602 10
		Mount Pleasant	25	12 5 6	ditto	513 10
		„	7½	13 15 6	ditto	
		„	7½	13 15 0	Newton, Keates & Co.	
		Hendre Ucha	13	12 3 6	Walker, Parker and Coo.	158 5
		Pool Park	14	12 3 6	Newton, Keates and Co.	170 9
		Dyliffe	70	12 10 6	Walker, Parker & Co.	876 15
		Roman Gravels	30	12 7 6	ditto	371 5
		Llangynog	20	12 2 6	Newton, Keates and Co.	242 10
		St. Pierre de Peona	20	4 1 0	ditto	327 2 6
		„	35	5 17 6	ditto	



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THE

MINING AND SMELTING MAGAZINE.

MARCH, 1862.

The Miners' Association of Cornwall and Devon.

By Robert Hunt, F.R.S.,
Keeper of the Mining Records.

The second general meeting of the Miners' Association of Cornwall and Devon has recently been held at Redruth. The council's report, and the supplementary reports of the educational and the financial secretaries, have been made. The public, therefore, who may be interested in this the most recent experiment in the way of giving a technical education to the miners, have the means of judging of the prospects of the Association becoming a permanent institution.

There is certainly much that is encouraging in the results obtained during the past year. One hundred and thirty persons, more or less connected with the mining operations of Cornwall, have been receiving instruction in chemistry, mineralogy and mechanics. A considerable number of these, considering all the circumstances of their position, passed with great credit the examinations of the Department of Science and Art, securing many of the best prizes which the Government offered. If the ability and the industry of an individual is to be judged of by the result of a public examination, then the young Cornish miner has shown considerable industry and great aptitude in acquiring knowledge. I am not, however, prepared to adopt this test as a conclusive one. These very examinations have forced on me the conviction that more than the average amount of intelligence existed amongst those young men who did not "pass" in the examinations of last May.

Minds vary infinitely in their conditions, these conditions being greatly dependent on the physical state of the individual. An examination is necessarily confined to a few hours, and within that time a nervously excitable or a timid man may be quite unable to collect his thoughts sufficiently to gather together the fragments of knowledge which are, as it were, scattered in his mind.

Let those, therefore, who did not succeed at the last examination "take hope again," and let not the enquirer suppose that the aptitude for knowledge was represented by the numbers—though these were

respectable—who did pass the peculiar examination of this division of the Education Board.

Enough has been done by the Association to show how much more may be done, if its machinery can be extended and its sphere of operations enlarged.

The one discouraging feature, which must not be disguised, is shown in the financial report. The expenditure has exceeded the income. This the financial officer endeavours to explain, or excuse, on the plea that large stores of chemicals, of apparatus, of books, and of materials for drawing have been purchased; and that these things are so much property acquired by the Association.

This is true; but seeing that nearly one-half the cost of these things has been defrayed from the "grant in aid" of the Department of Science and Art, it ought not to have happened that at the end of the first year of its operations the miners of Cornwall allowed an Association, *professedly at least*, working for the improvement of the mining interests, to find itself in debt.

It is, however, pleasing to record, that nearly one-half of the debt has been paid off since the general meeting; and that additional support is promised from mines and from individuals connected with mining.

The great question which the mining interest must consider, not cursorily, but deeply and thoughtfully, is, will the Association, if it can carry out its objects, produce any real improvement in the art of mining? or will the commercial advantages which we may expect to arise from increased knowledge, give us interest for the money which we may expend on the machinery necessary for imparting that knowledge?

Let us endeavour to take a fair and impartial view of this problem, standing on neutral ground, and fearlessly examining the merits and the demerits of the arguments which have been brought forward as answers to this, in every way, interesting question.

Mining has unquestionably been prosecuted for a long series of years by men who have not possessed any of the advantages which are supposed to be derived from education. That is, the miners as a class have not received the knowledge which is imparted by scholastic training. Their school has been experience—the experience bought by hard-handed toil—and by that peculiar kind of observing-faculty which is called into play by the system under which they work. This being the case, and seeing that the produce of our metalliferous mines has been steadily increasing with the demands, why, it may be asked, is it necessary to interfere with the existing order of things? Why trouble the miner with the acquirement of knowledge which his father did not appear to require, and without which he has hitherto earned his daily bread?

On the answer to these questions depends the propriety or otherwise of supporting the Miners' Association. The answers must therefore be clearly given.

As the questions have been put, there is one omission which bears importantly on the case. Mining has not gone on without the introduction of knowledge, of a new and extraordinary character, amongst our miners from time to time.

In the reign of Elizabeth the mining operations of England had fallen to so low a state, that the Queen, by the advice of her council, sent for several German miners, and offered them special privileges for introducing new and improved methods of mining into this country. These German miners worked the mines on the banks of the Tamar, and became so intimately connected with the mines of Cornwall, that we find one of them Vice-Warden of the Stannaries for many years.

Again, in 1783, mining in Cornwall was pursued under the utmost disadvantage, owing to the imperfections of the engineering. How instructive on this head is the following letter from Watt to Boulton:—

"Chacewater Company sunk £50,000 and upwards in setting that mine to work, and whether they have recovered it all yet seems uncertain, although the mine has been tolerably prosperous.

"Wheal Virgin Co. lost £28,000 in ten months' unprosperous working. Poldice has sunk a very great sum, and is not now gaining nor saving. It has cost £35,000 to fit up and drain Wheal Virgin in this working, and it costs above £10,000 a year to draw the water after all that can be done for them. Roskeer has been long languishing, and does not now pay costs. At Dolcoath Mine it is said they use £500 of timber per month, and a new kibble rope of above a ton weight is worn out in a fortnight. It takes full fifteen minutes to draw a kibble of ore there, which weighs only about 3 cwt. On the average, above two-thirds of the stuff drawn is barren stones. It cost three years' work, and, I believe, as many thousand pounds, to sink a new shaft in that mine: every fathom of an engine-shaft that is sunk under the engine costs from £50 to £100.

"United Mines have been at death's door, and are still in a tottering state. Wheal Union adventurers, after working nearly three years, were glad to sit down with a loss of £7,000 or £8,000. If we had not furnished them with more effectual means of drawing the water, I believe almost all the deep mines had been abandoned before now."

No one will deny the advantages which were derived from the introduction of improved machinery into Cornwall. Few will be prepared to deny the advantages of the competition which existed for many years amongst the engineers of the county, which raised the pumping engines of the West to the highest pitch of excellence, and which made the engine-houses of the Cornish mines patterns to the world for their order and cleanliness.

Other cases might be cited to prove, that, beyond the force of human muscle, the powers of the cultivated mind were being continually called into action to produce the results which we obtain from our mineral explorations.

For 3,000 years man has been working the rocks for the sake of their mineral treasures. The consequence is, that the riches which existed near the surface are nearly all gone, and it is only by plunging deeper into the earth that we can hope to maintain the supply up to the demand.

To do this with economy we must still improve our pumping and winding machinery. We must devise methods by which the labour of climbing shall cease; and the ventilation, which may now be

sufficient, will shortly become inadequate to the vital wants of the miner. Every process, if we would be successful, must be carried out in the best methods. Holes must be placed in the most favourable positions in relation to the jointed structure of the rocks. The whole power of the explosive agent must be brought to bear, without waste, with the maximum of force, on the mass to be moved.

One of our most celebrated agents recently stated that the greatest number of accidents in mines arose from the want of knowledge amongst the men of the strength of materials, and the best form of applying mechanical powers.

Dressing arrangements must still be improved. There are losses which ought not to arise, and which might be prevented by a careful study of the laws of fluid motion, and of gravitating power.

Mineralogy is allowed by all to be a want, and the means of detecting minerals a necessity. Therefore it is not expedient to extend the reply, by which we hope to prove that Mechanics, Mineralogy, including as much of Geology as deals with the structure of the older rocks, and Chemistry, in its application to Metallurgy, are branches of scientific education which should be offered to the miners at such a cost and with such conveniences that they can have no excuse if they do not profit by them.

The Miners' Association started with the following resolution, moved by Captain Charles Thomas, and supported by Mr. Charles Fox :—

"That this meeting approves of the formation of a society to be called the 'Miners' Association of Cornwall and Devonshire,' which shall devote itself to the encouragement and advancement of mining and mine engineering—promote the exchange of information and ideas—secure the record of the results of experience and observation—devise plans for the education of the practical miner in the branches of science which bear immediately on mining—establish local collections which should illustrate the geology, mineralogy and physical phenomena of each district—and by all available methods aim at the improvement of the great mining interests of Western England."

Let it not be forgotten that the aim of the Association is to offer that real knowledge which will be directly applied by the miner to his bread-getting. That by securing the attention of the miner to the advantages to be derived from certain branches of science a substantial benefit must be conferred on every man possessing mining property in the form of land or in the shape of shares.

The experience of the past year is of that character which creates a determination on the part of all the promoters of the scheme to work zealously towards the end indicated, and to wait patiently the result of their carefully directed zeal.

"All noble growths are slow," was the fine remark of Channing. The council of the Association desire to extend their operations, but, at the same time, they are endeavouring to consolidate the institution. At the last meeting the machinery was simplified, while the useful working power was increased. They feel with Addison's Cato that—

> "It is not in mortals to command success,
> But we'll do more, Sempronius, we'll deserve it."

The Burnley Coal-Field, Lancashire.

By Edward Hull, B.A., F.G.S.,
Of the Geological Survey of Great Britain.

The description of the coal-fields of Lancashire and Cheshire presented in the last number of this periodical would be incomplete, were we to omit a more special reference to the coal-basin of Burnley than it was in our power to give on that occasion.

On referring to the map which accompanies that description it will be observed that to the north of the darkly-shaded portion, which represents the richly-stored coal-tracts, there stretches a broken and indented region of Millstone Grit and lower Coal-measures. Now this region is not altogether barren of mineral fuel, but contains, throughout a vertical thickness of some four thousand feet of strata, several good coal-seams.* They are, however, never very thick, seldom reaching three feet. One or more of these seams, classed under the appropriate, though rather indefinite, name of "Mountain Mines," is worked over wide areas of moorland, occupying the central portion of South Lancashire and stretching into Yorkshire. Some of the coal-works amongst the Lancashire hills are of very rude and primitive construction—probably little changed for the last three or four centuries. In some places the seams crop out along the flanks of the hills, and are entered by tunnels or "day eyes,"—a miner's term, which any one who has crept or scrambled through one of these dark and low passages for a time, and at length caught a glimpse of the small distant opening into daylight will recognize as very expressive. In other spots, as amongst the hills north of Staleybridge, the seam is entered at the outcrop, and is tunnelled in the direction of the dip, or as it is termed "down-brow," to a surprising distance. The coal-trucks are hauled up the steep incline by a stationary engine planted in front of the entrance to the mine. In another instance, north of Rochdale, water power is employed. By an ingenious contrivance an over-shot wheel is made to raise the coal through the vertical shaft; but when not used for this purpose, the power is transferred, by means of a long lever, to a pump for draining the mine, and the whole process is managed by one banks-man. The hand-gin and the horse-gin are also here seen—monuments of a period when the power of steam was unknown, but which, like the different styles of architecture in ancient buildings, recall to our imagination the progressive stages of mining art in days gone by. They are, however, seldom employed, as in even very small concerns a dwarfish steam-engine is preferred, both for its economy and greater convenience. Some of the engines are of such diminutive size as to seem fitted only for playthings, and their utmost efforts are required to lift a single man, or a small "skip" of coal, to the surface from a depth of a few feet or yards.

Of the far-extending breadth of coal-strata which at one time overspread the hills of shale, grit, and conglomerate, lying to the north of

* See *Mining and Smelting Magazine*, No. 2, p. 87.

the Lancashire coal-field, the Burnley coal basin forms a small, but valuable remnant. It occupies a broad valley nearly enclosed by high and steep hills, and in its centre stands the newly incorporated town of Burnley. The hills which rise on either side are formed of Millstone Grit and lower Coal-measures (see fig. 1) which have been upheaved on the eastern side along the line of a great fault, beyond which the strata are nearly horizontal, and form a table-land, from whose centre rises a knoll containing a small outlier of the *Arley Mine.* On the opposite or western side of the basin, the strata rise and outcrop in rapid succession, and may be traced by the aid of many beautiful sections across Padiham Heights, Pendle Hill, down to the Carboniferous limestone of Clithero. At Burnley, the centre of the basin, the strata lie nearly horizontal, but are traversed by several faults. The northern edge of the middle coal-series is not, I believe, very accurately determined.*

The following are the series of coals at Burnley, near the centre of the basin, from the top downwards. The *Doghole* or *Top Mine,* 6 feet thick; the *Kershaw Coal,* 3 feet; *Shell Coal,* 2½ feet; the *Burnley Old,* or *Main Coal,* 5 feet; the *Maiden* or *Higher Yard,* 3 feet; the *Lower Yard* or *Four Feet,* 4 feet; Impure Cannel, 2¼ feet; *Thin Coal,* 2¾ feet; *Great Mine,* 4 feet, divided into two seams by a parting of shale. The above constitute the "Burnley top beds." They include about 36 feet of workable coal, distributed throughout 580 feet of strata; and below the *Great Mine* there are 200 feet of strata destitute of coal. Next underneath is found the Habergham series, consisting of the following coals in descending order: *China Bed,* 2 feet thick; *Dandy Bed,* 2 feet; *Fulledge Main* coal, or *Arley Mine,* 4 feet in thickness. This last, named after its supposed representative in the Wigan and Bolton districts, is the lowest seam of the middle Coal-measures. After reaching this well-defined geological horizon, we have to pass through 200 yards of strata or more (for the real depth has not been actually proved) before reaching the thin seams belonging to the Lower Coal-measures, or Gannister series. These, as stated by Mr. Whittaker, are as follows:—*Foot Mine,* with a hard gannister floor; the *Spa Clough Top Bed,* two feet and a half thick; *Spa Clough Bottom Bed,* four feet in thickness. At some distance, about a hundred yards underneath this last, is the Millstone Grit, with two or three thin seams which outcrop in the road near Height House.

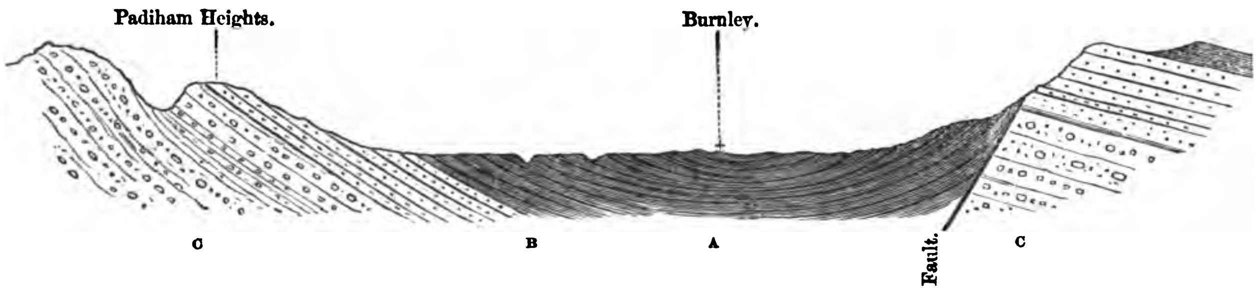
To sum up the above in a few words, the upper Coal-measures have been removed by denudation, which has also carried away a large portion of the middle series. This latter is about 1,020 feet in thickness, with 13 workable Coal-seams, containing about 40 feet of coal. The lower Coal-measures, which are from 1,200 feet to 1,500 feet in thickness, contain about 6 feet of workable coal divided amongst two beds.

The gannister rock of this district is a very marked feature in the series. It forms the floor of one or more seams, and instead of

* An interesting account of the formations of this district, with their animal and vegetable remains, was presented, by Mr. J. Whittaker, at the meeting of the British Association at Manchester, 1861, and is published in the "Geologist Magazine," vol. iv., p. 508.

Fig. 1.

SECTION ACROSS THE BURNLEY COAL-FIELD.



A. Middle Coal-measures, with thick Coal-seams down to the *Arley Mine.*
B. Lower Coal-measures, or Gannister Beds, with their Coal-seams.
C. Millstone Grit, from the "rough-rock" downwards.

assuming the usual character of *under-clay*, appears as a very hard compact silicious stone. It is sometimes four or five feet in thickness, and along Padiham Heights is in high requisition as a road material. It is in fact the hardest stone of the neighbourhood, only surpassed in this quality by the Carboniferous limestone of Clithero, and when struck by the hammer causes it to ring. Nevertheless it is a true under-clay or seat-stone; is penetrated in all directions by *Stigmaria ficides* (the roots of *Sigillaria*,) and has in all probability become indurated by the gradual infiltration of silex in solution. Indeed we may feel confident that it was not in its present state when the coal plants were rooted into it.

The area of the Burnley coal-basin is about twenty square miles. It contains a very large supply of mineral fuel for future use; probably enough to last for nearly 300 years at the present rate of production. Indeed it is only very recently that its true value has been thoroughly appreciated, as an impression had prevailed amongst the old miners that the coal-seams, along whose outcrop they and their forefathers had been working for generations, did not extend in the direction of the centre of the basin. A fuller light, the result partly of the spread of scientific knowledge, has dispelled this illusion, and the inferences which were fairly to be adduced from the structure of the strata and the margin of the basin, have been verified by actual experiment. It is now fully understood to be a true basin or trough, and the complete series of coal, as given above, has been satisfactorily ascertained by sinking at Burnley.

This district is also noteworthy as the residence of a goodly band of observers of natural phenomena, led and encouraged by Sir J. Kay-Shuttleworth, of Gawthorpe Hall, and it is not the least pleasing fact in connection with the subject, that amongst them may be reckoned several miners and working men, whose knowledge of the palæontology of the Carboniferous rocks would do credit to many who have had the advantage of superior education.

On the Mexican Method of Amalgamation.

By James Napier, Jun., F.C.S.

Late Chemist and Assayer to the Guanaxuato Mint, Mexico.

§ II.—GRINDING ORES AND SEPARATING THE GOLD.

In the introductory section I gave a brief sketch of the history of the Patio amalgamation process, and a few analyses shewing the general composition of some of the silver ores in certain of the Mexican mining districts. In the present section I propose describing the methods employed for grinding the ores and separating the gold; it being understood that my description refers particularly to the district of Guanaxuato. As the mode in which the sales of the ores are conducted is characteristic, I may be permitted to give a prefatory notice of it.

Sales of Ores.—Some of the poorer mines of Guanaxuato are worked by what are called "*Buscones*" (searchers). These are miners

answering to the Cornish "tributers," who work without any definite pay, but receive half of the value of the produce they extract from the mine. At stated times a sale takes place at each concern, when these *buscones* arrange in separate lots whatever they may have extracted since the previous sale, in the court-yard of the mine. These lots of ore are cunningly laid out, so as to expose the richest portions to the view, some shewing much taste in their arrangement; and each miner stands near his own lot and keeps it constantly sprinkled with water, which has the effect of making the mineral look darker and richer.

The various "*Rescatadores*" (purchasers) take from each lot a small portion of ore, as average a sample as possible, which they have finely ground, and tried or assayed on the spot. This is done by placing about a handful of the ground ore in a "*Jicara* *" or small round bowl, washing away the whole of the earthy particles, and judging from the metallic portion remaining of the richness of the ore. It is really astonishing to mark how by this rude process those who constantly practise it are able to arrive at results so near the truth. However, many purchasers have assays now also made by fire for greater accuracy, and in this case the samples are obtained the day before the sale. These assays are either made by scorification, or by smelting the mineral with red lead, crude carbonate of soda, a little charcoal and salt, and cupelling the resulting buttern of lead.

At the regulated hour for the sale a bell strikes, as a signal that it is about to commence. The person intrusted with the sale takes his place successively at the foot of each lot, and every buyer in turn whispers into his ear what he wishes to give for that parcel. When all have given in a price the lot is called over to the highest bidder, the rate of his bid being named; where two buyers bid the same amount, the first bidder gets the preference. The person acting as auctioneer and the rescatadores thus move from lot to lot till the whole of the ore in the yard has been disposed of. The weight of these lots of ore is not ascertained by weighing, but has to be judged of by eye. This, like the trying of the ore, is accomplished by those who have had long practice with remarkable accuracy; and, on the whole, one of these sales is rather exciting. The moment a lot of ore is called out to a buyer, the miner has nothing more to do with it; the purchaser having to remove it from the ore yard to his reduction works, or *Haciendas*. This is usually done packed in sacks on mules' backs; the ore, if in very large lumps, as it often is, being previously

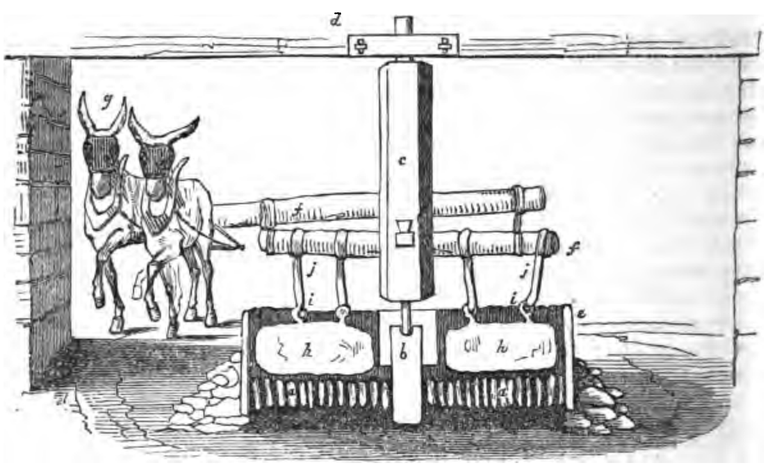
* Of these vessels Sonneschmidt has the following interesting remarks. "There is a tree which is found in some parts of the coast of this kingdom, (New Spain), which produces a round or spherical fruit of various sizes; they clean out this in the middle, and take away the pulp which it contains, when two cups called "*Jicaras*" or "*Chacules*," are taken out. Those employed for the purpose of assaying are about 7 or 7½ inches (Spanish) in diameter, and 3 or 3½ in depth. In the village of "*Olinalan*," where the Indians occupy themselves in the manufacture of these vessels, they are coloured inside and out with varnish and colour, and at times they have figures on their exterior. Besides being used for the above purpose of assaying, they are also used for domestic purposes, being found in almost every habitation. For this purpose it matters not what size or colour they are; but for the purpose of assaying they should be black or blue inside, because the red and green deceive the eye."

broken into moderately sized pieces. Each sack holds about 175lbs., and two of them are loaded on each mule.

Rough Stamping.—The first operation to which these ores are subjected is a coarse stamping. This process is carried out in what are termed "*morteros*" or "*molinos*," which are very similar to the stamps used at the Cornish tin mines. The extent of these *morteros*, or the number of heads, naturally depends on the extent of the "*Hacienda*," and they are worked by mule power, excepting in a few districts, where steam or water is employed. The ore, as it is fed to the stamps, is in pieces about the size of the fist; as it is stamped, it falls into a piece of strong hide, perforated with small holes, and fixed in an inclined position. What does not pass through the holes is again returned to the stamps, whilst the finer portion, called "*Granza*," a very coarse sand, is conveyed to the "*arrastres*" or fine grinding mills. One stamping mill or battery, with ten stamp heads, worked by six mules which are changed every six hours, is capable of stamping from three o'clock in the morning till seven in the evening forty cargas of fourteen arrobas* each.

Fine Grinding: construction of "Arrastres."—*Arrastres*, or as they are sometimes also called, "*Tahonas*," are round, and vary somewhat in size in different places; but those mostly used in the large *Haciendas* of *Guanaxuato* have a diameter of 4½ varas,† and are called "*Arrastres de marca*." The annexed drawing,‡ fig. 1, is a

FIG. 1.

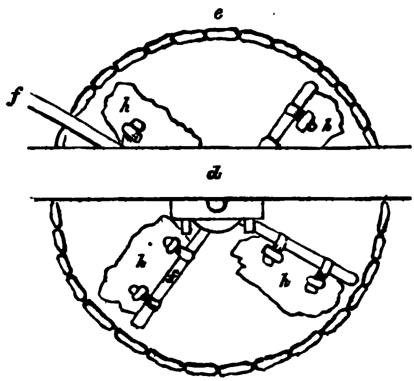


sectional elevation, and fig. 2, a ground plan: these will enable the reader to comprehend the construction of the mills. The bottoms are formed of hard stones, each stone being about from 28 to 30

* An arroba is 25lbs.
† A vara is equal to 33 English inches.
‡ For these drawings I am much indebted to Mr. John Phillips, formerly ry to the Real del Monte Company.

inches long, and about 4 inches thick; they are placed vertically one against the other, as shown at *a*, the interstices between being filled up with "*Cabecilla*" (the residue remaining after washing a torta) moistened with water. In the centre of the circle there is a massive

FIG. 2.



stone, *b*, which rises somewhat above the floor of the mill. To this is attached, by means of a pivot, an upright shaft *c*, supported by a cross beam *d* at the top. The sides of the arrastres are formed of flag-stones *e*, or in some places planks of hard wood, which rise above the floor about 2 feet. To the upright shaft *c* are attached two cross bars *f f*, to which to harness the mules and secure the "*Voladoras*" or grinding stones *h h*, which in Guanaxuato are of porphyry; their size being a little less than the radius of the arrastre, and being about 16 inches thick, the same height, and about 2 varas long. In each of these stones two holes are bored, into which are fixed wooden pegs *i*, to which the stones *h h* are attached by strings of hide or pieces of chain, *j*, to the cross bar *f*. For an arrastre of the dimensions given above, four grinding stones or voladoras are required, and two mules are necessary to work them.

Porphyry appears to be the stone best suited for the purpose of forming grinding-stones, from the fact of its being coarse-grained, and presenting a rough surface to the last. Basalt, which is very plentiful in the district of Real del Monte, is there used for this purpose; but, although sufficiently hard, it very soon becomes smooth, and passes over the ore without having the same grinding effect as porphyry.

As soon as the bottom of an arrastre has been put in, a new "*Voladora*" is set to work to grind "*Cabecilla*" mixed with water. This ensures the whole of the interstices being filled up, and is continued for one day, when a second stone is attached. At the end of three days a third is added, when the grinding of poor ores may be gone on with, and after four or five days the fourth stone is added and the fine grinding gone on with.

Fine grinding in Arrastres and extraction of Gold.—In districts such as Guanaxuato, where the ores contain gold as well as silver, the

former metal is generally in such small quantities that if extracted as an alloy with the whole bulk of the silver it would scarcely pay the cost of extraction, at least in Mexico, but by adopting the plan of keeping the arrastres charged with mercury during grinding, the gold is concentrated and made to yield very handsome profits. When this method of concentrating the gold was first used in Mexico we are not at present aware, but Humboldt states that he was informed it was in use in some districts in 1804, but that it was not employed in Guanaxuato, where he was, nor did he see it in operation.

The quantity of ore from the stamping mills charged to each arrastre at one time varies according to circumstances; however, in the best regulated works in Guanaxuato, where the grinding is without doubt carried to greater perfection than in any other district in the republic, an arrastre of the dimensions given above is charged with from six to seven quintals.* To this is added a barrel of water —about ten gallons—which is enough to bring the mass to the state of a thick cream. On the quantity of water added depends much the quality of the grinding which will result. Humboldt states that in no part of Europe had he ever seen such fine grinding as in the Great Haciendas de Plata of Guanaxuato. If the arrastre be a new one, or one from which the amalgam has just been removed, there is added from 5 to 10lbs. of silver amalgam: that is, after the arrastre is well "*ascentado*," or in good working order. Some amalgamators prefer having this amalgam very "dry," or containing but little free mercury; whilst others again prefer employing it with more mercury. However, it appears to be certain that the less mercury it contains the better, up to a certain point. The reason given for adding amalgam instead of mercury alone, is, that if mercury only were added it would run immediately into the crevices of the bottom, and thus be of little or no use; whereas the amalgam is spread by the action of the stones over the whole surface of the bottom. This I think is true; but it is also evident, from experiment, that amalgam will take up gold and silver much more readily than pure mercury, and that up to a certain extent the freer the amalgam is from mercury the better will it take up the gold and silver. Might not many of the gold amalgamating machines patented of late years in this country have succeeded much better had amalgam been added in place of so much pure mercury? I mean, amalgam from which only a small quantity of mercury would ooze when pressed between the finger and thumb.

From time to time during the 24 hours (the usual time required to grind the above weight of ore) water is added to the arrastre as follows:—The arrastres are charged about four o'clock every morning, when, as we have already stated, one barrel of water (10 gallons) is added; at nine o'clock another, and sometimes one and a half; at eleven o'clock another barrel and a half; at twelve o'clock one barrel; at three o'clock, three barrels, and at five o'clock four barrels—in all twelve barrels, or about 120 gallons of water. This quantity will vary somewhat with different classes of ores. The grinding should be so perfect that no grittiness be felt between the fingers

* A quintal is equal to 100lbs.

when the hand is inserted into the mass. As the operation goes on, the amalgam gradually searches into the crevices of the arrastre. Every second morning, a small portion, called a "*Tentadura*," or sample of the amalgam ("*Pella*") is taken from each arrastre, cleaned well with water, and its condition examined. From its "dryness" or "moistness," that is to say, from the greater or less quantity of mercury which can be expressed by pressing it with the thumb against the inside of the "*jicara*" containing it, is judged how much, or if any, fresh mercury will have to be added to the next grinding; for the almagam is not removed but at the shortest every three months, unless the ores be unusually rich in gold, when the arrastres are freed from amalgam. The usual amount of fresh mercury added to each arrastre during grinding is about half a pound every second day. However, this will vary very much with the ores operated upon; but as a rule the amalgam should not contain more than about 20 per cent. of gold and silver. At the end of the 24 hours, when the grinding is concluded, the "*lama*" or slime is baled out with wooden bowls ("*Bateas*") about half a vara in diameter, into a barrel, in which it is carried and poured into a place prepared for its reception. In some haciendos it is baled into a small wooden launder which leads to the receptacle; and in other works each arrastre is furnished with a large plug near the bottom, which, when opened, allows the thin slime to run through conduct pipes to the receptacle. When the slime is removed by hand with a bowl, there is laid on the bottom of the arrastre a small plate of lead or iron, so as to prevent the bottom from being scraped and any of the rich amalgam being removed by the bowl. This operation lasts but a very short time, about half an hour, and when concluded a fresh charge of *granza* from the stamps is added, and the grinding again gone on with as we have described. Two mules, which are changed every six hours, are attached to each arrastre. In this operation there is generally an augmentation of weight to the extent of about 8 or 10 per cent. from the wearing away of the grinding-stones. In most cases the arrastres are arranged in a double row in a house called a "*Galera*" (gallery). The bottom of an arrastre will last about twelve months, but the "*Voladoras*" or grinding stones do not last more than a month, and in many instances not even so long.

There appears to be an alloy of gold and silver which will not combine with mercury. My friend, the late Mr. Henry Mackintosh, who had long experience in these matters, stated to me that on two occasions he had found an alloy of gold and silver which he could not get to amalgamate after continued grinding with mercury for six months. Mr. Mackintosh could not remember the composition of this alloy, but he thought it contained about 50 per cent. of silver and 50 per cent. of gold. Sonneschmidt, in speaking of the action of mercury on gold, states—"On various occasions I have seen native gold very finely divided that would not combine with mercury, which I thought was owing to the surface being covered with some foreign matter; at the same time, if this was the case, the film was so small as not to be perceptible."

Removing amalgam and clearing out arrastres.—"*Raspando*" (scraping) is the name given to the operation of removing the amalgam,

of silver and gold from the arrastres. It is done as follows. At the end of about every quarter, or sometimes only every half-year, according to the quality of the ores being ground, after the arrastres have been discharged, the workmen proceed to scrape all the stuff from the interstices between the stones forming the bottom, which they do with hooked pieces of iron. The stuff removed is a mixture of coarse pieces of stones—are very finely ground—and amalgam of silver and gold. If the arrastre be entirely worn out, the whole bottom is removed and everything well scraped and cleaned, when a new bottom is again put in.

That which has been collected from the bottom is next well washed by hand, in large wooden bowls, in a tank filled with water. A certain portion of the stuff to be washed being placed in the bowl, there is then added a small portion of mercury for the purpose of collecting the finer particles of amalgam, and prevent them, as much as possible, from being washed away by the water. The bowl is now moved about in the water in such a way as will best favour the collection of the heavy amalgam and the removal of the lighter or earthy particles which are collected in the bottom of the tank, and is again washed on an inclined plane called a "*Planilla*," so as to obtain as much as possible of the precious amalgam. Still, some of this is in such a fine state of division, from the long-continued action of the grinding stones, that much of it is lost even by the second washing, and no method has yet been invented by which the last traces of this finely divided portion can be saved. The amalgam, after having been collected and cleaned, is freed from as much mercury as possible by being pressed in a leather bag; the dry amalgam is next burned (as we shall describe further on) to expel the remaining portion of the mercury, when an alloy of gold and silver remains. This is next removed to the Government melting and assay office to be melted into bars and assayed, before being sent to the mint to be "*parted*." This alloy is termed "*Plata mixta*" (mixed silver.)

Loss of Gold.—By this method of grinding there is still a large loss of gold. From 25 to 33 per cent. on the assay may be taken as an average, and it is said by some to be as high as 40 per cent. The whole of this loss has never been satisfactorily accounted for; but there is always a certain portion washed away in the form of very fine amalgam in washing the stuff from the bottom of the arrastres. The silver obtained from the treatment in the patio always contains a certain amount of gold, and the "*Polvillos*," which are the metallic portions (principally sulphides of iron rich in silver) remaining from the washing of a torta, always contain gold. These "*Polvillos*" are treated a second time to retain whatever gold and silver they may hold; but they will not yield them by the common method, without a preliminary operation. I think it quite probable that the gold may exist in these *Polvillos* as a sub-sulphide.

Loss of Mercury in the Arrastres.—In many of the works which treat on this subject it is stated that it is only the native metals that are taken up or extracted in the arrastres, and the "*Asogerros*" (amalgamators) in general think that to amalgamate any quantity of the precious metals an equivalent weight of mercury *must* be sacrificed. It is, however, very evident that in the arrastres the mercury

actually acts on the sulphide of silver, forming metallic silver and sulphide of mercury. The following gives the details of an actual result obtained in a reduction works at Guanaxuato. The amalgam added to the arrastre was 70 lbs., and was composed of 14 lbs. of silver and 56 lbs. of mercury :—

Additional mercury added during the whole time of grinding (exclusive of above)	330 lbs.
Mercury in amalgam added	56 „
"Plata mixta" (gold and silver) obtained, including the above 14 lbs.	84 „
Amalgam which *ought to have* been produced ...	470 lbs.

But there were only obtained 400lbs., which was composed of 84 lbs. of gold and silver (plata mixta) and 316lbs. of mercury; which, deducted from 386, the total number of pounds added, leaves a loss of 70lbs. Now the alloy contained 18lbs. of gold, which being in the metallic state in the ore would combine with the mercury without loss of the latter. Consequently, if we subtract this 18lbs. of gold from 84lbs. (the total alloy) there will remain 66lbs of silver. Thus we have a loss of as near as can be one pound of mercury for every pound of *silver* taken up (nearly equivalent proportions), the difference being easily accounted for by mechanical loss in washing, burning, &c. Again, the ores worked in Guanaxuato contain but little or no native silver, the gold only being in that form; so that it can only be the slow reduction of the sulphide of silver by the mercury, and the conversion of the latter into sulphide, that causes the loss. If the ores ground contain much native silver, then the loss of mercury will be less in proportion. Or, if copper amalgam in place of that of silver be added to the arrastres at the commencement of the grinding, the copper will in a short time disappear, and the loss of mercury will be somewhat diminished.

The reduction of sulphide of silver by mercury is a very curious fact, and one which I believe has been pointed out before. Still the following statements may be interesting. I took a small piece of pure red sulphide of silver and ground it *dry* in a clean porcelain mortar for about ten minutes with a small portion of mercury. At the end of this time the mercury contained a considerable quantity of silver, which could only have come from the reduction of the sulphide. In conducting this experiment, it is curious to note that after having ground the two substances together for a few seconds, the whole of the sulphide of silver *apparently* disappeared, and the mercury had all the appearance of being highly charged with silver (of amalgam) and spread itself in the form of a paste round the interior of the mortar; but on adding water to wash out what we thought was a pure amalgam, we were disappointed at finding the mercury again asssuming the globular form, having only taken up a small portion of the silver, whilst the remaining undecomposed sulphide of silver mixed with the water. This circumstance, I think, can only be explained by the mercury actually dissolving the sulphide of silver, which apparently can only take place in the dry state.

The following table gives a list, approximately accurate, of the Reduction Works in Guanaxuato, with the number of arrastres or grindin mills in each in 1859.

Name of Reduction Works.	Number of Mills.	Name of Reduction Works.	Number of Mills.
Casas Blancas	50	Brought forward	698
Santa Ana	20	San Luisito	18
San Juan	36	Patrociño	20
Purisima	36	Puerta Grande	26
Trinidad	24	San Jaronimo	50
Barrera	68	San Francisco	30
Barrera en Medio	26	Pastita	50
Dolares Barrera	36	San Agustin	26
San Antonio	24	Noria Alta	22
Cipreses	20	San Nicolas	10
San Pedro	24	Cruz Blanca	14
Rocha	80	De los Pinedas	6
Pardo	30	Puente de Palo	18
San Francisco	16	Luna	30
Flores	30	Duran	20
Dolares	30	San Matias	22
Salgado	56	San Javier	34
Escalera	54	Various small Works	30
San Joaquin	18		
Bustos	20	Total Number of Mills	1,124
	698		

Abstracts and Reviews.

HISTORICAL NOTICES ON COPPER SMELTING IN GREAT BRITAIN.

(From Dr. Percy's "Metallurgy.")

In the time of Elizabeth there was a rich copper-mine at Keswick, in Cumberland, of which that Queen deprived the Earl of Northumberland, on the ground that it was a mine-royal.* It is reported that not less than 4,000 men were employed at this mine; but this is probably a great exaggeration. The ore appears to have been a sulphide; for Webster, the author of the "Metallographia," describes it as an ore "that must be often melted in the fire ere it be brought into the form of good copper." According to Camden, much good copper continued during a long time to be made at Keswick and Newland; but Webster, in 1671, wrote that "now the work is quite left and decayed; yet I am informed that some do now melt forth as much very good copper as serveth them to make half-pennies and farthings."†

* Some Account of Mines, and the *Advantages* of them to the Kingdom. By Thomas Heton, M.A., Vicar of *Layston, in Hertfordshire*, &c. London, 1707, p. 15.

† "Metallographia," etc. By John Webster, etc. London, 1671, p. 244. I have cited Camden on the authority of Webster.

More ancient records of copper-mines exist: thus Edward III., in the fifteenth year of his reign, granted the right of working "the copper-mines of Skildane in Northumberland, and the copper-mine of Alston-Moor in Cumberland, and the copper-mine near Richmond in Yorkshire, during a term of fifteen years, and on payment of a royalty to himself of one-eighth, and one-ninth to the lord of the soil," to a company of adventurers, amongst whom his brother Richard, Duke of Gloucester, and Henry, Earl of Northumberland, are mentioned.* That the copper-ore which was raised in these earlier times was smelted at or near the mines, I think there is reason to suppose, notwithstanding the absence of any positive historical record of the fact. The Hindoos have smelted copper from time immemorial; and to this day conduct the operation in small blast furnaces about three feet high, with charcoal and cow-dung as the fuel. The ores which they employ are not those of the easily reducible class, such as carbonates, but sulphuretted ores, like copper-pyrites. But, if these rude tribes of mankind are able to smelt copper-ores with success, it is not difficult to believe that our ancestors, at least those of the fourteenth century, possessed an equal degree of metallurgical skill. Moreover, it appears certain that copper-ore was raised in this country many hundred years ago, and it must either have been smelted at home or exported; but I am not aware whether there is any historical evidence of the fact of such exportation; if not, we have an additional though negative argument in favour of the supposition which I have above ventured to express, concerning the early history of copper-smelting in England. On the other hand it should be stated, that our ancestors imported copper from Hungary † and Sweden, and allowed calamine to be exported as ballast.‡

Copper-works were in operation in Yorkshire during the last century. Mr. Keates has communicated to me the following particulars on this point:—"Copper-smelting, I believe, was carried on in Yorkshire to a limited extent; but all that I know of it was told me by old Samuel Burgoyne in 1822, who at that time was eighty-four years of age, and was consequently born in 1738. His father worked at the copper works at Middleton Tyas, in Yorkshire. He said, 'The ore was green and red, and melted by blast. The work stopped when I was about twelve years, and we came to live at Ecton.'" Mr. Keates has furnished me with a copy of a memorandum which confirms the preceding statement:—"April 17th, 1752.—Assayed the sample of Middleton Tyas round ore brought me by Mr. Rotton's son. Quantity T13. c4. 2qrs. 13lbs. . . . . . 20 dwts. produce 9 dwts. of fine." This shows that the ore yielded 45 per cent. of fine copper. Jars states that in 1765 copper-smelting in this locality was effected in reverberatory furnaces, and that various kinds of ore were raised from the neighbouring mines, amongst which he mentions green carbonate of copper, vitreous copper, and rarely yellow ore, or copper pyrites.§

In Staffordshire copper-smelting was carried on at the village of Ellaston, near Ashbourne. The ore was obtained from the well-known Ecton mine in the vicinity. Specimens of this ore, which I have seen, consist of copper-pyrites in association with calc-spar. Plot, writing in 1686, informs us that when he visited Ecton, the mine had ceased to be worked, and that at the mills at Ellaston, where they smelted three kinds of ore, "all was out of order," the famous *wooden-bellows* that had no *leather* about them "having been carried away to Snelston, in Derbyshire," whither he went to see them. From this it is clear that the smelting was conducted in

* Heton, op. cit., p. 9.

† See Specification of Patent to George Danby, A.D. 1636. Jan. 21.

‡ Heton, op. cit., pp. 153, 154.

§ Voyages Metallurgiques, 3, p. 72.

blast furnaces.* According to Plot, the stoppage of the mine and smelting works was on account of "*Copper* coming cheaper from *Sweden* than they could make it here."

The working of the Ecton mine was resumed; and Mr. Keates informs me that about 1750 the ores raised from this mine were smelted at Whiston, and some of the copper was carried to a forge at Bosley, on the river Dane, near Macclesfield, where it was hammered out into pans, &c. Other Staffordshire copper-ores were smelted at Cheadle about 1780. Mr. Keates has also communicated to me the fact that copper-ore was raised at the Ribden Mine, distant a few miles from Alton Towers, and smelted at a place in the vicinity called "Blazing Star," on account of the light emitted at night; so that a blast furnace was probably employed. The ore consisted chiefly of carbonate and oxide of copper. Webster states, on the authority of one Dr. Merrett, that a copper mine existed at Wenlock, in Staffordshire.†

The following historical notice of copper-smelting in Lancashire has been kindly supplied by Mr. Keates:—

"The first introduction of copper-smelting into Lancashire was by the ancestor of the present Colonel Patten; the works were at Bank Quay, on the banks of the Mersey, near Warrington. The building of these works commenced in 1717 or 1718. The ores were principally Cornish and Irish, with small importations from the West Indies and the British Colonies in North America; some also were got from Alderly Edge, Coniston, &c. These works were dismantled, I believe, about 1780. The next works in Lancashire were built very near Liverpool: the present Mersey Iron and Steel Works stand on their site. They were carried on by Roe and Co., who had a brass manufactory at Macclesfield. Cornish and Irish ores were smelted at these copper-works, which were discontinued about the year 1800. Next in succession were the works at St. Helen's and at Stanley, a few miles distant. These works were of considerable magnitude, and were established by the father of the late Lord Dinorben and his partners for smelting the ores raised at the Parys and Mona Mines in Anglesea. I have not the exact dates, but I believe they were begun about 1780, and discontinued between 1812 and 1815. Copper-smelting then ceased entirely in Lancashire, but was resumed in 1830, when the writer built works at Ravenhead, near the site of the old St. Helen's works, primarily with the object of smelting the ore raised at the mines of General Bolivar in Columbia, the legislature having granted permission to import and smelt foreign ores in bond, on condition that the produce should be exported in the state of cake or ingot copper. The works at Sutton, near St. Helen's, were also built by the writer shortly after those at Ravenhead; and these have been followed by others, so that at present the quantity of fine copper smelted from ore in Lancashire is probably not less than 6,000 tons per annum. The principal ores smelted are from the west coast of South America, Canada, Cornwall, Ireland and Wales, together with the sulphides of low produce imported by the chemical manufacturers from Spain, Portugal, &c., who first extract the sulphur from them and then turn them over to the copper-smelters."

In the last century copper-smelting was carried on in Gloucestershire, at Bristol, and other neighbouring localities; but I have not been able to ascertain when it was first established in this country, or when it was discontinued.

Jars published, in 1781, a description of the smelting of copper in the vicinity of Bristol. There were two works to which the greater part of the ores raised in Cornwall were conveyed by sea. Reverberatory furnaces were used, of which there were not less than fifty in one of these works.

* The Natural History of Staffordshire. By Robert Plot, LL.D.: Oxford, 1686.
† Op. cit., p. 244.

The regulus, preparatory to calcination, was broken and ground under edge-stones by horses.*

Aikin, writing in 1797, states that at Amlwch port, in North Wales, the poorest ores of the Parys Mine, which yielded only from 1¼ to 2 per cent. of copper, were partially smelted, so as to produce a regulus containing 50 per cent. of copper, which, together with the rich ores, was exported to Swansea. There were two companies, each of which had a smelting-house, in which were thirty-one reverberatory furnaces.†

Copper-works were established by the Union Company, at Risca, near Newport, Monmouthshire, in 1807, and continued in work till 1817, when the copper trade being much depressed, the smelters determined to reduce the number of works; and they accordingly drew lots to decide which works should be given up. The lot fell upon the Risca works, which were consequently abandoned, and the buildings have since been used as chemical works.‡

We now arrive at the history of copper-smelting in South Wales. In Carew's "Survey of Cornwall," of which the first edition was published in 1602, is the following passage:—"Touching metals: Copper is found in sundry places, but with what gain to the searchers, I have not been curious to enquire, nor they hasty to reveal; for at one mine (of which I took a view) the ore was shipped to be refined in Wales, either to save cost in fuel, or to conceal the profit.§ From the evidence which I shall adduce, and for which I am indebted to Mr. G. F. Francis, it may be certainly concluded that the first copper-smelting works at Swansea were not erected until after 1720; and that anterior to this date copper-smelting works existed at Neath.

In George the Third's collection of topographical engravings, in the British Museum, I have found a curious old Indian ink drawing of copper-works at Llangefelach, the parish adjoining Swansea; and though I do not know when they were erected, yet it will be shown in the sequel that they were in operation in 1745.

From the evidence which has now been advanced we may, I think, conclude with certainty that copper-smelting had been extensively carried on at or near Neath for a considerable period before it was established at Swansea; but I have not yet succeeded in obtaining more precise information on this subject. Carew, however, it will be remembered, states that copper "was refined in Wales;" and as this statement was published in 1602, there can be no doubt that copper-smelting was in operation in the Principality before that date. The term *refined*, in the passage quoted from the "Survey of Cornwall," is evidently used as synonymous with our present word *smelted*. Hence, unless it can be shown that when Carew wrote, copper-smelting was conducted in other parts of Wales, we may reasonably infer that the art had attained a considerable degree of development at or near Neath at least 120 years prior to its introduction into Swansea. It must be left to future antiquarian researches to elicit more precise evidence on this subject than we at present possess.

In Cornwall during the last century several unsuccessful attempts were made to smelt copper, of which a record has been preserved by Tonkin; and as the history of these failures may convey an important lesson to

* Voyages Metallurgiques, 3, p. 222.

† Journal of a Tour through North Wales, &c., by Arthur Aikin; London, 1797, p. 133, et seq.

‡ I am indebted to Mr. Octavius Morgan for this information concerning the Risca works.

§ Carew's "Survey of Cornwall;" to which are added Notes illustrative of its History and Antiquities; by the late Thomas Tonkin, Esq., and now first published from the original manuscripts by Francis Lord De Dunstanville; London, 1811, p. 21. See also the note p. xii, as to the date of the first edition.

persons engaged in mining adventures, I insert this record without abridgment: it is contained in Lord de Dunstanville's edition of Carew's "Survey of Cornwall," and was evidently prepared in 1739 with a view to publication:—*

"This variety of ores and great increase in the mines has occasioned the setting up of six several companies for the buying of the ore, but who take care to keep us as much in the dark as they can, by shipping off all the ore to be smelted in their houses near Bristol, in Wales, &c., under a pretence of saving cost in fuel, but in reality to conceal the profit, as Mr. Carew very justly observes; so that we must be entirely at their mercy, as, not understanding the true value of the commodity ourselves, or, if we did, they know that it would require a greater purse than any one private gentleman can be supposed to be enabled to lay out. It was, however, attempted about thirty years since by the late John Pollard, Esq., and Mr. Thomas Worth, jun., at St. Ives; and before them by Mr. Scobell, at Pol Ruddan, in St. Anstell, with whom the late Sir Talbot Clarke and the old Mr. Vincent joined, and when the first piece of copper that ever was so (*sic*) in this country was smelted, refined, and brought to perfection. But both these attempts failed of success, more through ill-management, roguery of the workmen, and the ill situation of the said smelting houses, than any defect in the ore, or charge of the fuel. Since this, one Gideon Collier, of St. Prian-in-the-Sands, erected a house for the like purpose, at Penpol, in the parish of Phillack: but being soon taken off by a fever, in the best of his time, when he had made a fair progress in it, the same was carried on by the late Sir William Pendarves and Robert Corker, Esq., who have (particularly the last, with whom I have often discoursed about it,) assured me that they could smelt their ore as cheap there, all hazards considered, as the companies could pretend to do at their houses in Wales, &c., and did so accordingly for some years. But they being both since dead, and their affairs falling into such hands as had other interest to mind, this project too sunk with them. A small beginning was also made to the same purpose at Lenobrey in St. Agnes', where they smelted some pieces of copper with good success; but were forced to give it over for want of a sufficient stock to go on with it. From all which essays, and some observations I have made of my own and gathered from some workmen abroad, but chiefly from the late Mr. John Coster, who owned to me that most of our ores might be smelted rough here as cheap as abroad, but not brought to the true fineness (for what reasons you may easily guess), and therefore must be shipped off to be refined, I am fully convinced that the ore may be smelted here, and refined too (that pretence being a mere cant to conceal the real value), all things considered, at as small an expense as it can be done in Wales, &c. And if we allow for the great salaries the said companies are obliged to give to their agents here and elsewhere, the great charges they are at in working the mines (which they covet at any rate to get into their own hands), the hazard of the ore on shipboard, especially in time of war, and many other incidents, which would be saved if the ore was smelted here, I believe it would amount to a demonstration that it would even be done much cheaper in some convenient places in this country than in Wales, &c. What advantage from this would accrue to our country in general is too obvious to need any more words; and this the copper companies know but too well, and therefore keep us as much" * * * * * *

[Left unfinished by the Author.]

In 1754 copper works were erected at Entral, in the parish of Camborne, and afterwards removed to Hayle, where coal could be procured at a less cost. According to Price, the [copper] companies left no method unsought

* P. 22.

to traduce the credit and stab the vitals of this undertaking. Threats and remonstrances were equally used to oblige or cajole the owners of the mines to abandon or suppress the new company at Hayle. The opponents of this association, using every expedient to mortify the spirit of this arduous undertaking, alternately raised the price of copper-ores, and lowered the value of fine copper, to the great loss of the contending parties, which will ever be the case where monopolies are disturbed and the almighty power of opulence can prevail. But happening to have men of fortune and capacity at their head, they were founded in prudence, and withstood the shocks of power and artifice."* The same author informs us that copper works were subsequently erected at North Downs, in Redruth; but the locality proving unsuitable, they were removed to Tregrew, on a branch of Falmouth harbour, where they were carried on with advantage.

From the language of these writers, it is evident that the Cornish mine adventurers considered themselves the victims of a conspiracy on the part of the Welsh copper-smelters. But it is difficult to understand why copper-smelting should have ceased in Cornwall if it had really been so profitable as Price declares. In one instance, at least, failure was not due either to deficiency of capital or incapacity in the management. As the adventurers felt themselves so much aggrieved by the smelters, they might have entered into a combination to keep up the price of copper-ore. Of all facts, none are more stubborn than those of political economy; and the truth of the matter appears to be, that copper-smelting can be conducted with greater profit in Wales than in Cornwall; and, therefore, it has become extinct in the latter county. When a man has an article for sale he ought to know how much it has cost to produce it, and to fix such a price upon it as he considers remunerative. So the miner should determine the value of the ore which he raises, irrespective of the profit which it may subsequently yield to the smelter; and he has no right to impute injustice to the smelter who declines to inform him of the gains arising from the metallurgical treatment of the ore, and to allow him to participate in those gains, which often entirely depend upon the exercise of individual skill and the possession of sound commercial knowledge. Whatever the profits of copper-smelting may have been in former times, it is certain that the smelters of the present day do not, in general, realize more than they are fully entitled to expect.

The last county to be mentioned in which copper-smelting has been conducted is Middlesex. About fifteen years ago works were erected on Bow Common for the purpose of smelting copper by a process devised and patented by Mr. James Napier, which will be described in the sequel. The locality was not suitable, and, as might have been anticipated, the works were speedily abandoned. The chief promoter of the undertaking was, I believe, the late Mr. Benjamin Smith, the silversmith, of Duke Street, Lincoln's Inn Fields.

Towards the end of the last century, probably between 1780 and 1790, copper-smelting was carried on at Ballymurtagh, Wicklow, Ireland. Through the kindness of Mr. Moyle, of Chatham Dockyard, I have received the following information on this subject from Mr. Edward Barnes, the present resident director of the Ballymurtagh Mines, now worked by the Hibernian Mining Company. Mr. Barnes writes that, "when we first commenced the mine, none of the persons employed at the works were living, or at least remaining in the neighbourhood, and no records are to be found in the office of the Hibernian Mining Company on the subject. I think I have heard it stated that the smelting works were erected by English parties, the Mining Company selling them the ore as raised. At

* "Mineralogia Cornubiensis." London, 1778, p. 279.

the period referred to, I rather think a considerable export duty was levied upon copper ores, which, added to the low produce of the ore of Ballymurtagh and its high per centage of sulphur, were the chief causes of erecting smelting works near the mine. An attempt was also made to save the sulphur by combining the ores in rude kilns in the open air, the sulphur fumes being received into long horizontal flues. This process was very slow and unsatisfactory, and there is reason to believe the Company were losers by it. Judging from the cleanness of the slag at Ballymurtagh and at Arklow, it would appear that the process was well carried out and no copper left in it; but no doubt there must have been great disadvantage in operating upon one stubborn class of ore. The Company had a patent for coining their own copper tokens, as had also the Associated Irish Mining Company at Cronebane, who tried smelting on a smaller scale. This, I believe, was a general medium of payment with similar companies at the period."*

It would be difficult to select in this country a more eligible site for copper-smelting works than Swansea; and this for two reasons. The first is, that it is a good seaport, which is only at a short distance from Cornwall and Devonshire, the two counties in which the greatest amount of copper-ore is raised, and it is also easily accessible to vessels conveying ore, or products containing copper, from South America, Australia, and other parts of the world. The second is, that extensive collieries exist in the immediate vicinity, from which an abundant supply of coal can be obtained at a low price. Many of the smelters are themselves engaged in the working of collieries, and are thereby enabled to dispose of their coal to the greatest advantage, the large being sold at a good profit, either for home consumption or exportation, and the small, which is often very *dirty* from an admixture with shale, being reserved for the copper-furnaces. It is advantageous, both for the mine-adventurers and the smelters, that the process of smelting should be carried on in a locality where copper-ores of various kinds may be procured, for it is well known that frequently copper can be extracted at a less cost by smelting several ores in admixture than by smelting any one ore by itself. An illustration will make this point plain. Suppose we have two kinds of very poor ore, one consisting almost wholly of oxide of iron and the other almost wholly of quartz. It might not be profitable to smelt either separately; for, in the case of that of oxide of iron, it would be requisite to add quartz as a flux, and in the case of that of quartz, it would be requisite to add oxide of iron as a flux. But it might be profitable to smelt the two ores together, as one would then serve as a flux to the other, and each would yield copper. This is not an imaginary case. The smelter, by having at command a variety of ores, may render an ore profitable which otherwise would have no value. Adventurers in copper mines would do well to consider this matter, and to be cautious how they embark capital in the erection of smelting works which can only derive a supply of ore from some one particular mine. However, I do not mean to assert that particular copper ores cannot be smelted with profit. The advantages which Swansea possesses as a site for copper-smelting are shared in a greater or less degree by other localities in the vicinity, such as Neath and Llanelly. The copper works near the Lancashire coast may be well situated for the importation of ores, for the exportation of copper from Liverpool, and for supplying the great local demand in Lancashire and the West Riding of Yorkshire; but they cannot obtain coal at the same price as Swansea and its neighbours. The Swansea smelters enjoy the privilege of pouring dense volumes of thick sulphureous and arsenical smoke from comparatively *low* chimneys into the atmosphere, and destroying vegetation

* MS. Ovoca Lodge, Ovoca, May 9th, 1861.

with impunity for a considerable distance round. This privilege has now in the lapse of time become an established right, which would not readily be conceded in many other parts of the kingdom. The inhabitants of Swansea generally seem to be habituated to the inhalation of the smoke, and to submit to the evil, if evil it be regarded, with unmurmuring resignation.

THE *ANNALES DES MINES* ON THE PRESENT POSITION OF THE METALLURGY OF IRON IN ENGLAND.

Annales des Mines, ou Recueil de Mémoires sur l'Exploitation des Mines, et sur les Sciences et les Arts qui s'y rapportent. Rédigées par les Ingéneurs des Mines, et publiées sous l'Autorisation du Ministre des Travaux Publics. Cinquième Serie. Tome XX. 1861. Paris: Dunod, Quai des Augustins.

(Second Notice.)

IN our last number we gave a brief abstract of certain portions of the first part of the memoir in the *Annales des Mines* on "The present State of the Metallurgy of Iron in England," by MM. Gruner and Lan. The second part is continued in Vol. XX., occupying the greater part of the fourth *livraison* for 1861: from it we proceed to make the following abstracts.

SUCCESSIVE MODIFICATIONS IN THE WORK OF ENGLISH FURNACES SINCE 1835. —The improvements which have been effected in English iron works in this respect during the last thirty-five years may be classed under the following heads:—

1. *Economy of Combustible.*—The economy in this respect has been principally brought about by the adoption of the hot blast, and the substitution in certain districts of raw coal for coke. The simple enlargement of the throat of the furnace, also, has effected a considerable saving in the amount of combustible consumed; although, with regard to this modification, its advantages have been evidently exaggerated by Truran, who attributes the economy of fuel realised in iron-making in England during the last 30 years almost exclusively to this enlargement of the throat!

Most of the improvements date from a period between 1830 and 1835, and have been already described in the second edition of *Voyages Métallurgiques*. The consumption has also been reduced, in certain works, by reducing the character of the produce. Instead of *grey* forge, they seek only to produce *mottled* feebly carbonised. This is especially the case in Wales, particularly where a large addition of forge cinders or very siliceous red hæmatites is used. It may be questioned, however, if such an economy is not bought too dearly by the depreciation of the products, for such pigs can only produce very mediocre iron or rails, and that with a greater waste than in the case of ordinary pig iron. The reduction of the ores in this case is, besides, always incomplete, and their yield consequently less.

Finally, another means of economising the combustibles, which has been employed for some time in France and Germany, is the utilisation of the gaseous products of blast-furnaces. In this respect the English iron-masters have been long and are still behind their continental brethren, as has been pointed out by Mr. S. H. Blackwell, in his "Lecture on the Iron-making Resources of the United Kingdom." The first attempts in this respect were made in England in 1845, at Ystalifera and Ebbwvale. At present, the furnaces of Cleveland, and half of those in Wales, utilise the gases for the heating of the air and the boilers, while it is still the exception in Staffordshire and Scotland. Many English iron-masters, and Mr. Truran at their head, maintain that it is impossible to utilise the gases of a blast furnace

without deranging its operation. This is, indeed, true in the case of large throats, and when the draught brings the gases along the circumference of the furnace, or along the surface of the materials; but all inconvenience disappears when they are taken through the centre by means of apparatus arranged like those of M. Coingt de Montluçon. From this yet incomplete utilisation of the gases, it results that on an average there is more coal consumed per ton of pig-iron in England than in France. But the consumption has, nevertheless, been considerably reduced within the last 30 years in the English iron-works.

In 1830, the consumption in Wales per ton of forge pig averaged 4 tons of coal; at present, in the works where the gases are utilised, from 2 tons to 2½ tons. In Staffordshire, for grey forge pigs, about 1830, the consumption was from 6 tons to 6½ tons; at present, with calcined ores of about 40 per cent., it averages about 4 tons. In Scotland, before the employment of raw coal and hot air (1828) the consumption was from 7½ to 8 tons of coal, calcining and engine included; at present, with calcined ores of from 55 to 60 per cent., it is only from 2 tons 8 cwt. to 2 tons 12 cwt. Lastly, in Cleveland, where the gases are well utilised, from 2 tons 16 cwt. to 3 tons is burned in heated calcined ores. In France, on the other hand, in a considerable number of works, the consumption does not exceed from 2 tons to 2 tons 4 cwt., when the coals are highly carburetted, and the ores of the mean produce of those of Wales, Cleveland and Staffordshire (40 per cent.), as at Loire and Creusot. But also when the ores are poor, as at Aubin and Decazeville, and the coal weakly carburetted, the consumption rises equally to 4 or 5 tons.

2. *Increase of Production.*—The mean production of blast-furnaces has been more than doubled within 30 years, which has necessarily considerably reduced the general expenses.

Twenty-five or thirty years ago, the blast-furnaces of Wales produced, on an average per twenty-four hours, from 8 to 9 tons of forge-pig, and those of Staffordshire 7 tons. At present, taking with Mr. Hunt the mean of all the works, we find the return 20 tons in the first district, and from 12 to 13 in the second; but many blast-furnaces reach from 15 to 20 tons in Staffordshire, and from 30 to 40 tons in Wales. We find, similarly, 19 tons as an average in Cleveland, and 20 tons in Scotland, instead of 7 tons thirty years ago.

This increase is entirely due to the enlargement of the body of the furnaces, for the production per cubic content is not greater now than formerly. The rate of the descent of the charge, and the time required for the reduction and fusion of the ores, have remained sensibly the same. The augmentation of the volume has been besides rather effected in width than in height; the diameters of the belly and the throat have been especially modified, and rarely the height of the body.

Nevertheless, in order to push the production of blast-furnaces, it does not suffice merely to increase the volume—it is also necessary to augment proportionally the volume of air. Therefore, the volume or number of the blowing cylinders has been nearly doubled, and, in certain cases, the pressure of the air increased at the same time. In certain works, those of Cleveland and Staffordshire in particular, in order to double the volume of air, the section of the existing tuyeres has been doubled; elsewhere, they have increased the number. Thus in Wales they have advanced from 2 or 3 to 5 or 7, and in Scotland even to 8 or 10.

3. *Improvement in Mechanical Appliances.*—The principal modification introduced into the mechanical appliances employed in blast-furnaces is the transformation of the blowing-engines. Formerly, the old Watt type of engine—low pressure and condensing—was only used, the diameter of the cylinder of the engine being exactly half of that of the blowing cylinder. Now, high-pressure engines are usually used: and to the adoption of these

alone, Truran attributes the enormous saving of a half or even two-thirds per cubic foot of air, in the coal consumed. The fact is, however, that other simultaneous modifications have equally contributed to make up this great saving. The high-pressure engines have one great advantage in being able more readily, at any given time, to augment rapidly the motion, and consequently the pressure or volume of the air.

The apparatus for raising the materials, and the consequent cost of this operation, have been generally simplified. Where blast-furnaces are not built at the foot of a hill-side (where the materials can be wheeled direct into the furnace) instead of the old inclined planes, or vertical chain lifts, water-balances are generally used, and in the most modern works, like those at Cleveland, the pneumatic lift, which is a kind of gasometer of small diameter, but a little higher than the furnace itself. This is evidently, of all lifting appliances, the most simple, and the least subject to derangement.

Among appliances which aid the reduction of the necessary expenses we may mention the iron waggons into which the slags from the furnaces flow directly, and which are subsequently removed by rail.

Hot air apparatuses have been but little modified in England during the last 25 years. In this respect, and in that of the utilisation of the gases, the iron-masters of the continent have nothing to learn from those of England.

4. *Reduction of the Cinder.*—A last modification, which helps to reduce the cost of the production of pig-iron, is the employment of forge cinders in place of ore. The cinders are a rich ore of small value, but their reduction is difficult and always incomplete; besides, they not only whiten the resulting crude-iron, but render it besides very siliceous, and charged with phosphorus. This means, therefore, cannot be had recourse to, except in the case of the making of pig-iron of a quite inferior quality. This is the case in the Welsh works, where in general they re-smelt, without exception, the whole of the cinders derived from the refining; and it is the same in the case of certain establishments in Staffordshire, where inferior iron is made at a low price. But in the greater part of the works of this district, and in all those of Cleveland and Scotland, the employment of cinders is the exception, and when it is used it is always in very small proportion. Indeed, the use of cinders gives an economy more apparent than real. As soon as the proportion of cinder is pretty great, the half of the oxide of iron in the cinders almost always passes directly into the slags.

Forms and Dimensions of Blast Furnaces.—Under this head a vast amount of valuable information is given as to the form, relative production, and character of produce of the various types of blast furnaces in use in Great Britain. This portion of the memoir, which is illustrated by Plate III. accompanying this number of the Magazine, we find too lengthy to include this month, particularly as it comprises several tables. We must consequently postpone it until our next number, as the matter will not bear separation.

On the Chemical Composition and Origin of Granite and other Rocks; an Address delivered before the Geological Society of Dublin, by the Rev. Samuel Haughton, F.R.S., President, on 12th February, 1862.

Although the purpose of our Magazine is primarily practical, and consequently implies an exclusion of lengthened notices on purely scientific matters, we think it will be unnecessary to apologise to our readers for laying before them the following abstract of Mr. Haughton's address on a subject which has recently created so much interest among geologists; and

which has, more than any other branch of that science, such important practical bearings, particularly as elucidating the mode of origin of metalliferous deposits.

"In former addresses to this Society, I have invited your attention to various astronomical theories of the original formation of our planet, of the internal heat of the globe at present, and of the causes of change of climate. On the present occasion I purpose to follow up my former addresses, by giving you my views as to the mineralogical and chemical composition of the rock masses of which the earth is composed; and in so doing I shall carefully distinguish my own speculations from the numerous and well-ascertained facts observed by myself and others, more especially the chemical geologists of Germany and France, in which countries, the physical and chemical laws at work among our rocks, and the physical history of our globe itself, receive that attention which their importance demands, and which they, in vain, solicit from the eyes and pens of English geologists.

"I adopt as the fundamental hypothesis of the physical history of our globe the nebular theory of Laplace, and the physico-chemical hypothesis of Durocher, which supposes the two outer layers of our globe (on cooling from the molten conditions required by the hypothesis of Laplace) *to have* acquired their relative positions of outer and inner layer, not only by virtue of their relative specific gravities, but also in accordance with their definite chemical compositions; so that the specific gravity of each layer, which by the action of mechanical laws fixes its position in the earth, is itself the result of its chemical and mineralogical composition.

"The hypothesis of Laplace is so well known, that I do not feel it necessary to describe it; but that of Durocher is so little known or understood, that I gladly avail myself of the present opportunity to offer it *to you* in his own words:—

"'An immense number of consequences may be logically derived from the following proposition, the proof of which I shall furnish *presently*, viz.:—*That all igneous rocks, modern and ancient, were produced by two Magmas, which coexist below the solid crust of the globe, and occupy there each a definite position.*

"'The Upper Magma, which is rich in silica, and poor in earthy bases and oxides of iron, possesses the least specific gravity; and in this respect there are differences among the rocks produced by the two Magmas, from one and a half to twice as great as between oil and water. The separation is still greater if, in place of considering the rocks in their natural condition, we compare the vitrified products obtained by their fusion: further still, if we refer them to their liquid condition, there ought to be, according to Bischoff's experiments, between the rocks arising from the two Magmas, differences twice greater than those observed in their crystalline state, and, therefore, from three to four times greater than those between oil and water: from these facts may be deduced the necessary and permanent separation of the two Magmas.

"'These two Magmas have undergone but slight changes of composition from the most remote geological epochs; and, moreover, they differ essentially from each other by means of well-defined characters. The one may, from its excess of silica, be called the Acid Magma; while the *other* is comparable to a basic salt; for its silica is not in sufficient quantity to saturate its metallic oxides, The difference of silica in the two Magmas is in the proportion of 7 : 5. They contain nearly the same quantity of Alumina; but the Siliceous Magma contains from one and a half to twice as much alkalies, and more Potash than Soda, while the reverse occurs in the Basic Magma. The first is specially characterized by its poverty in earthy bases, and the iron oxides; of these it contains from six to eight times less than the other.

"'The following Table gives the composition of these Magmas, and the specific gravities of the rocks derived from them,

	Proportions of Elements.			
	Mean Proportions in the two Magmas.		General Limits of Proportions in the Igneous Rocks.	
	1. Siliceous	2. Basic.	1. Siliceous.	2. Basic.
Silicia	71 ·0	51 ·5	62 to 78	45 to 58
Alumina	16 ·0	16 ·0	11 to 20	11 to 20
Potash	4 ·5	1 ·0	3 to 6	½ to 3
Soda	2 ·5	3 ·0	1 to 6	1 to 6
Lime	1 ·0	8 ·0	½ to 2	5 to 12
Magnesia	1 ·0	6 ·0	½ to 2	3 to 12
Oxides of Iron and Manganese	2 ·5	13 .0	½ to 4	7 to 20
Water, Fluorine, Carbonic Acid	1 ·2	1 ·3	½ to 3	½ to 4
Specific gravity of Rocks, viz.—				
1st. Natural	2 ·65	2 ·95	2 ·4 to 2 ·7	2 ·8 to 3 .2
2nd. Vitrified artificially	2 ·40	2 ·72	2 ·35 to 2 ·46	2 ·5 to 2 ·84

"'By combining the results I have obtained by chemical and mechanical analysis with those of the analyses already published by various mineralogists, I have established that igneous rocks of crystalline texture, and almost all compact or vitreous masses, formed by fusion, and wrongly considered as minerals, are derived from one or other of these Magmas. To the first are referable all the Granitic rocks, including the Eurites, Quartziferous Porphyrics, and Petrosilex, the Trachytes, Phonoliths, Perlites, Obsidians, Pumices, and Lavas, with Vitreous Felspar. To the second belong the Diorites, Ophites, Euphotides, Hyperites, Melaphyres, Traps, Basalts, and Pyroxenic Lavas.'—*Essay on Comparative Petrology, Annales des Mines*, vol. xi. 1857.

"The two outer layers of our cooled globe to which Durocher applies the terms Acid and Basic Magma, respectively, may be conveniently designated as the First and Second Layer; and in one form or another, Durocher's hypothesis is now generally accepted by physical geologists. In its chemical view of the igneous rocks it is not original, as a similar proposal to regard all igneous rocks as the result of the mixture of two types of rocks was published long ago by Bunsen, and very generally adopted by German geologists; but in its physical view of these type rocks, as the outer and inner layers of the globe, by virtue of their relative specific gravities, it is Durocher's own, and justifies his claims to be regarded as one of the most brilliant and ingenious of geological investigators. I adopt Durocher's speculation, as I do that of Laplace, as a convenient hypothesis, summing up, in a form easily remembered, a crowd of concurrent facts, and being as near an approach as the limited knowledge of man can make to probability in the obscure region of science with which it deals.

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"A consideration of the stratified rocks of the globe confirms the opinion, that carbon is to be regarded as a product of the atmosphere, like oxygen, nitrogen, and hydrogen, and not as a mineral. We are acquainted with but two important origins for carbon; viz., our coal-beds and lime-stones. The former of these are confessedly the result of vegetable organic life, and derive their origin from the vital power possessed by the Vegetable Kingdom, of obtaining carbonic acid from the atmosphere, fixing its carbon, and returning the oxygen to the air;—the latter source of carbon, limestone, owes its origin in great measure to the vital power possessed by Corals and other members of the Animal Kingdom, of fixing carbonate of lime in their

skeletons, and so gradually laying the foundation for the formation of beds of limestone. But from what source was the carbonate of lime derived? Durocher's theory of the Basic Magma supplies us with silicate of lime and magnesia in abundance; and it is certain that the decomposition of the rocks derived from this layer of the earth, by the action of an atmosphere containing carbonic acid and water, would furnish in abundance the limestones and bolomites that abound in the later periods of the earth's history.

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"In confirmation of the preceding theory, I may remark, that the absence of limestone-beds in the older rocks has attracted the notice of almost every geologist, no matter in what country they have been studied. This paucity of limestone rocks is easily accounted for, by the consideration of the fact that the denudation and erosion of the outer layer of the globe could only supply materials for the formation of slates and sandstones, and that the limestone could not be formed until the eruption of portions of the second layer supplied the lime and magnesia requisite for their formation.

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"If the foregoing views respecting the arrangement of the layers of the earth, according to their chemical composition and consequent specific gravity, be considered probable, one effect of their adoption must be to destroy the positive value of such speculations as those of Mr. William Hopkins and Mr. Hennessey as to the thickness of the supposed solid crust of the globe, These speculations are essentially founded on the hypothesis of Legendre and Laplace, that the specific gravities of the different layers of the globe depend only on the pressure to which they are subjected; and if the specific gravity should turn out to depend rather on the chemical composition of the layer than on its pressure, the law founded on the latter hypothesis would become worthless, and such speculations as I have alluded to, however ingenious as mathematical exercises, would cease to have a real value as applied to solve the problem of the thickness of the earth's crust •

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"Before enquiring, however, into the origin of granite, it is necessary to inquire what granite is; and it is strange that, even on so elementary a question, there should be a difference of opinion.

"If we ask the opinion of Bunsen, or, at least, of his followers, they will tell us that granite is a mixture of ten parts of his Normal Trachytic Rock, with two parts of his Normal Pyroxenic Rock.

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"If we consult English geologists, they will give us the unsatisfactory information, that granite is composed of quartz, felspar, and mica, without stating what felspar or what mica is included in the definition, and that, if hornblende appear instead of mica, the rock ceases to be a granite, and should be called a syenite.

"And, finally, if we ask the opinion of the highest authority on this subject (Gustavus Rose), he has informed us that the presence of Oligoclase, as well as of Orthoclase, is requisite to constitute a true granite.—*Vid, Zeitschrift der Deutschen-Geologischen Gessellschaft*, vol. i. 1849.

"Bunsen's definition of granite is a mathematical fiction, the English definition has no precise meaning, and that of G. Rose is insufficient. Granite is not a mixture of two rocks; its minerals do not exclude Hornblende, nor do they necessarily include Oligoclase.

"In Ireland, which is as rich a field for the study of the igneous rocks as England is for the study of the fossiliferous rocks, we have in Leinster a granite which contains quartz, orthoclase, margarodite, lepidomelane, and a periclinic paste, as its constituent minerals. In the Mourne Mountains we have a granite containing quartz, orthoclase, albite, green mica, lepidomelane, and an undescribed paste; and in Donegal we find a granite containing quartz, orthoclase, oligoclase, margarodite, lupidomelane, and an

unknown paste. These Irish granites are quinary, and even senary, in their composition, and are as truly granites as the pegmatite of Caernarvon, which is composed exclusively of quartz and orthoclase, and is binary in its composition.

" What logicians would call the "essential difference" of granite appears to be '*a crystalline structure visible to the eye, and the presence of quartz and orthoclase.*'

" Adopting this as our definition, granites may be classified as—

1. Binary...	...	Quartz and orthoclase.
2. Ternary	...	Quartz, orthoclase, white mica.
3. Quaternary...		Quartz, orthoclase, white mica, black mica.
4. Quinary	... α.	Quartz, orthoclase, oligoclase, white mica, black mica.
	β.	Quartz, orthoclase, oligoclase, black mica, hornblende.
	γ.	Quartz, orthoclase, albite, black mica, hornblende."

In this classification, the author purposely omits the alleged ternary compound of quartz, felspar, and talc named Protogene—of which he denies the existence, either in the Alps or Cornwall, where it is said to occur. He dwells at considerable length on this point, as illustrative of the modes of investigations pursued in ascertaining the real constituents of rocks, which are by no means so simple as may at first sight appear. The following are the general conclusions arrived at respecting the origin of granite, which we think cannot fail to interest our readers, particularly coming as they do from one of our few English Geologists who have seriously investigated this branch of geological science.

" With respect to the igneous or aqueous origin of granite, Geologists in recent times have almost unanimously advocated the igneous theory, and Chemists the aqueous theory.

" The evidence of the Geologists has been collected in the field, and though it is wanting in the scientific precision which the Chemists have called to their aid, yet it possesses a force which all the arguments on the other side have, as yet, failed to oppose. The evidence in favour of the igneous origin of granite is essentially physical, and founded on the observation, in the field, of the manner in which granite is found to penetrate, in minute veins, every rock older than itself with which it comes in contact. It appears to me that no pasty condition of granite, such as that imagined by our distinguished honorary member Delesse, and that no aqueous solution of granite, can account for the remarkable group of physical facts which geologists have collected on this subject since the days of Hutton; and that we must admit that when granite penetrated the schists and limestones beside it, in small veins, it must have had a liquidity greater, perhaps, than that of any lava with which we are acquainted, except, probably, the siliceous lava of the Sandwich Islands. On the other hand, the arguments derived from chemistry appear to me equally unanswerable, in showing that water was present in abundance during the formation of granite, and that in some cases it is even to be regarded almost in the light of a chemical precipitate from an aqueous solution.

" Before attempting to reconcile these opposite views, let us consider for a moment the arguments of the Chemists. They are as follows :—

" I. The specific gravity of the quartz that occurs in granite is known to be 2·6, which Count Schaffgotsch has proved to be the specific gravity of silica formed by aqueous solution; while the specific gravity of silica which has undergone igneous fusion is only 2·2.

" II. Fuchs has shown that in granite we have several minerals—quartz, felspar, mica—whose points of fusion are very different; and yet they have not crystallised in the order of their infusibility, but in the inverse order, viz., of their fusibility; the most infusible of them all, quartz, having crystallised last, and acted the part of a mother-liquor to the others.

"III. Professor Heinrich Rose observes that the presence of such minerals in granite as Oligoclase, the Micas, Hornblende, &c., in presence of free silica, is inconsistent with the hypothesis of igneous fusion; as such fusion would convert these minerals into more highly silicated forms.

"IV. Lastly, the actual presence of large quantities of water (4 per cent.) in margarodite mica, which forms an important constituent of the granites of Leinster and Donegal; and the occurrence of such minerals as Allanite, Gadolinite, &c,, in the Norway granites, minerals which intumesce and change their properties on ignition; the presence of such minerals as these in granite appears to many chemists inconsistent with the theory of igneous fusion.

"Of these arguments, I confess that the first and fourth alone appear to me to be conclusive; and that the force of the second and third may be evaded by an appeal to our ignorance of the manner in which "liquation" may operate in determining the order and manner of crystallization of minerals forming on the cooling of a mixed magma, after igneous fusion. Indeed, with respect to the second argument, which requires quartz to crystallize first in granite, I am only acquainted with two rocks in which this condition has been fulfilled, by the separation of the quartz in the form of double hexagonal pyramids. These two rocks are—the felspar porphyry of Forkhill, in the county of Armagh, and the granite of Slieve Corragh, in the county of Down. The prophyry of Forkhill would be pronounced by any geologist to be a metamorphic slate, and not a fused rock, and yet it fulfils Fuchs' condition of igneous fusion, by the apparent order of crystallization of its constituent minerals.

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"The only manner in which it seems possible to reconcile the opposite theories of the origin of granite, derived from physical and chemical arguments, is to admit for granite what may be called a Hydrometamorphic origin, which is the converse of what is commonly called metamorphic action, but which might more properly be designated as Pyrometamorphic action. The metamorphism of rocks might thus be assumed to be two-fold: Hydrometamorphism, by which rocks, originally fused, and when in liquid fusion, poured into veins and dykes in pre-existing rocks, are subsequently altered in specific gravity and arrangement of minerals, by the action of water acting at temperatures which, though still high, would be quite inadequate to fuse the rock; Pyrometamorphism, by which rocks originally stratified by mechanical deposition from water come to be subsequently acted on by heat, and so transformed into what are commonly called the metamorphic rocks.

"Granite, it appears to me, although generally a Hydrometamorphic rock, may occasionally be the result of Pyrometamorphic action; and such appears to have been its origin in Donegal, in Norway, and, perhaps, in the chain of the Swiss Alps."

GEOLOGICAL SOCIETY OF LONDON.

At the meeting of February 5th, Sir R. I. Murchison, V.P.G.S., in the chair, Captain William Henry Mackesy (79th Highlanders), Waterford; Harry Seeley, Esq., Woodwardian Museum, Cambridge; and Thomas F. Jamieson, Esq., Ellon, Aberdeenshire, were elected Fellows.

The following communications were read:—

1. "On some Volcanic Phenomena lately observed at Torre del Greco and Resina." By Signor Luigi Palmieri, Director of the Royal Observatory on Vesuvius. In letters addressed to H.M. Consul at Naples, and dated December 17th, 1861, and January 3rd, 1862. [Sent from the Foreign Office, by order of Earl Russell.]

The evolution of gases,—the outburst of springs of acidulous and hot water,—and particularly the upheaval of the ground at Torre del Greco to a height of 1·12 mètre above the sea-level, are mentioned in this communication.

2. "On the Recent Eruption of Vesuvius." By M. Pierre de Tchihatcheff. Communicated by Sir R. I. Murchison, V.P. G.S.

M. Tchihatcheff's observations were made at Torre del Greco and Naples from December 8th to 25th. Near Torre del Greco several small craters (9—12) have been formed close to each other in an E.N.E.—W.S.W. line, at a distance of about 600 mètres E.S.E. of the crater of 1794; and either on a prolongation of the old fissure, or on one parallel. The phenomena mentioned by Signor Palmieri were also described by M. Tchihatcheff in detail.

3. "On Isodiametric Lines as means of representing the Distribution of Sedimentary (clay and sandy Strata), as distinguished from Calcareous Strata, with special reference to the Carboniferous Rocks of Britain." By E. Hull, Esq., B.A., F.G.S., of the Geological Survey of Great Britain.

The author, in the first place, made a comparison of argillaceo-arenaceous with calcareous deposits, as to their distribution, both in modern and in ancient seas, and stated that he objected to calcareous strata being regarded as sediments, in the strict sense of the word. After noticing the distribution of sediments in the Caribbean Sea, he referred to the relative distribution of limestones as compared with shales and sandstones in the Oolitic formations (comparing those of Yorkshire with those of Oxfordshire), in the Permian strata of England, and in the Lower Carboniferous strata of Belgium and Westphalia. After some observations on the nature of calcareous deposits, and on the contemporaneity of certain groups of deposits dependent on the oscillatory movements of land and sea, the author described his plan of showing on maps the relative thicknesses of the two classes of strata under notice, by means of isodiametric or isometric lines (properly *isopithic*, or indicative of *equal thickness* of the strata).

Mr. Hull then proceeded to show the application of the isodiametric system of lines to the Carboniferous strata of the midland counties and north of England; showing that there is a south-easterly attenuation of the argillo-arenaceous strata, and a north-westerly attenuation of the calcareous strata. The existance, in the Carboniferous Period, of a barrier of land crossing the British area, immediately to the north of lat. 52°, was insisted upon; and, although this barrier was probably broken through (in South Warwickshire) in the latter portion of that period, yet it divided, in the author's opinion, the coal-area into a north and south portion, the latter having a very different set of directions in the attenuation of its strata; the shales and sandstones thinning out eastward; the limestones in the contrary direction.

In conclusion, the author stated that, in his opinion, the sources of the Carboniferous sediments was in the ancient North Atlantic Continent, for the existence of which Lyell, Godwin-Austen, and others have argued; and he inferred that the shores of this *Atlantis*, composed principally of granitoid or metamorphic rocks, were washed on the west side by a current running S.W., which drifted the sediment in that direction; and, on the other, by a current running S.E., which carried sediment over the submerged British area.

MANCHESTER GEOLOGICAL SOCIETY.

At the ordinary meeting of January 28th, Joseph Dickinson, Esq., F.G.S., President, in the chair, the following communication was read:—

1. "On the Bank Top and Hagside Pits; and the Proving of Faults." By Andrew Knowles, Esq.

The Bank Top Collieries are about one mile from Bury, and are worked by two shafts, one of which reaches the mine at 130 yards deep, and the other at 160 yards. The mine is supposed to be identical with the Rushby Park of St. Helen's, the Arley of Wigan, and the Royley of Oldham. The Hagside Pit is 760 yards to the deep of the first of those shafts; being 280 yards in depth to the coal, and 300 to the bottom of the sump-hole: it is 11 feet 3 inches in diameter, and is used for pumping, and as a down-cast to the Bank Top Collieries, which are both up-casts. There is nothing of peculiar geological interest in connection with the mine. For many years the coal worked at Bank Top was principally to the rise of the pits, and as this was becoming exhausted, openings were commenced by driving a down-brow to the deep of the mine. When this had been driven 660 yards, a fault was met with which proved to be a down-throw, the coal being found in boring 26½ yards below the tunnel. This coal having been reached by a tunnel, driven with a dip of 1 at 1, and the driving continued 17 yards down the mine, a large up-throw was met with. The height of this having been ascertained by climbing up the vein, the coal was recovered by another tunnel, from the end of which a level was driven in the coal to where the Hagside pit would come down.

With regard to the proving of faults, the author gives the following opinion:—The dip of the coal, before you arrive at it, generally shows whether the fault is a down- or up-throw; but supposing you arrive, without any previous indication, if it is a down-fault the direction is away from you; or if up, you touch the vein first in the floor of the driving. Having found the direction of the throw, the best way to prove its extent is to go up or down in the vein, on the furthest side, so as to be certain not to miss the coal. In proving up-throw faults it is best to take two places up parallel with, and near each other, so that cut-throughs may be made easily. This insures better ventilation—gives two exits for the men in case of any ground coming together—enables the coal to be more effectually proved when reached—and generally facilitates the workings.

In a colliery where the ground is much broken, working expenses are heavier and the risks greater than where there is a clean coal to work at. But there are few collieries that are not troubled with faults more or less; and, although their disadvantages are great, they are not without some compensation. They decidedly do two things: they form an efficient barrier against water, the future utility of which may be discovered, and they keep the gas in the coal, which makes it better and freer to get.

In the discussion which followed Mr. Knowles's paper, the President made some remarks on the doubts entertained as to the identity of the Bank Top seam with the Royley or Arley mine. If they were not identical, he knew of none other that could correspond with the Bank Top except the Cannel mine.

Mr. E. W. Binney agreed with Mr. Knowles in his reserve as to the identity of the seam. Founding his views chiefly on Mr. John Hall's opinion, he thought this was not the Arley or Dogshaw seam. With regard to faults, the paper was very valuable. Geologists laid down faults with rules; but if every coal-proprietor would come forward like Messrs. Knowles, we should get some practical knowledge, and not be so inclined to draw faults in straight lines.—Mr. George Charlton suggested, that, besides forming natural barriers for water and for retaining the gas, faults might be made extremely valuable as natural divisions in ventilation. In reply to the President, Mr. Charlton also said, that, as a rule, with smaller faults the strata was not changed on either side, but with larger faults they were much changed. Some desultory conversation having ensued on the advantage of steel drills instead of those of iron tipped with steel, the discussion closed.

2. "On the Ventilation of Mines," by Mr. Joseph Goodwin.

Referring to the accident at Hartley New Pit, the author proceeded to consider how far it was safe to trust to a bratticed shaft for ventilating coal mines. Under every point of view it presented an unfavourable aspect; but was probably most at fault in its effects on ventilation. After describing the size and air-capacity of the Hartley New Pit, he asked,—If an explosion should take place where this system is practised, what hope is there for either the safety of the workman, or the employer's property?

After referring to some general properties of gases, the author again returned to the Hartley Pit, and showed that the capacity of the shaft in that case was unequal to the proper ventilation of the workings. He quoted from George Stephenson and James Mather several paragraphs against the practice of working with one shaft; which, in his opinion, not only immeasurably increases the risk to both employer and employed, but, pecuniarily considered, gives no real advantage in working a colliery.

Referring to some former observations as to sudden outbursts of gas, he wished to state that he was not aware of such having occurred in newly-opened mines, or in driving narrow work, which should be the time for these sudden emissions to take place. Are there not mines worked so as to convert the old workings into huge gasometers? We can understand that our fall of roof, or a decrease of barometrical pressure, would force the fire-damp out of these. He suggested the collection of authentic information on this subject, to enable us to understand more clearly what is meant by such a vague and indefinite term as "*sudden outbursts of gas.*"

In conclusion. the author made some general remarks as to the propriety of interfering with the discretion of the owners of collieries on the matters referred to, particularly as to the number of shafts.

In the discussion which followed, Mr. Binney said he had heard the system of trusting to one shaft condemned for twenty years. He doubted whether one shaft were cheaper than two. In Scotland, where you see a great number of these bratticed pits, the repair of the brattices is a constant source of expense. With regard to outbursts of gas, he considered that gas does come out of crevices, and it has been proved over and over again that it does come out.—The President remarked, with regard to the Hartley accident, that we would soon have the government return as to the number of pits in the country with only one entry. No doubt the system of brattice shafts has received the sanction of eminent mining engineers, but it was one he objected to. Yet it would not do for the inspectors to be too dogmatic in the matter, for the arbitration clauses left them but little power. As to the outburst of gas, at the last meeting some persons denied *in toto* that such ever took place. For his own part, he had been in the habit of going into mines daily for years before an outburst came under his notice, and he was then probably as sceptical as Mr. Goodwin. But since then he has had evidences of sudden outbursts of gas brought under his notice about which there could be no question. Within a few days of their last meeting an outburst of gas occurred in the lower Bent Mine, at Hollinwood. In the part of the workings where the inburst of gas took place, a great noise was heard while the men were at work. A man said the whole place was coming in, and the description given by the others was that it was like an earthquake. The timbers were suddenly snapped in two in the middle, and before the men could move, the gas burst up from the floor, and lighted for about 30 yards in length. There was an excellent current of air.—Mr. Wynne agreed that blowers were often made an excuse for bad ventilation, but he could bear witness to outbursts of gas coming when least expected, against which no ventilation can provide. As to the shaft question, in his opinion nothing was safe but two shafts. In some way or other accidents are sure to happen unless the shaft is duplicated. He remarked that there were only two brattice shafts in his district.—The President said there were not many in his, and some of the owners were anxious to do away with them. The Page Bank accident (Durham) where

the brattice took fire and shut up a large number of men, should have given a deathblow to brattice pits.—Mr. George Charlton said, single shafts were sunk in the North of England because of the great expense of sinking; but if the coal would not pay for sinking two shafts, it ought to remain until of sufficient value to do so. He believed Mr. Dunn was doing all he could to get two shafts. With regard to outbursts of gas, he agreed with Mr. Goodwin it would be more correct to say there had been suspension of ventilation.—Mr. Goodwin replied, that the doubt in his mind was, whether the sudden emanations of gas were such as not to be overcome by 20,000 cubic feet of air per minute, or whether they could be called outbursts below that point. He never disputed that emanations of gas took place.—The President remarked, that it was not always practicable to bring 20,000 feet of air into some places: therefore, there was nothing but the safety-lamp. —Mr. Goodwin had great objections to the safety-lamp, unless corresponding exertions are made in ventilation.—The President replied, that as an adjunct to ventilation the safety-lamp was invaluable, and the discussion closed.

On the 19th February, Mr. H. C. Salmon read a paper at the Society of Arts, (Thomas Topwith, Esq., F.R.S., in the chair) "*On the Relative Merits of the Different Systems of Working Metallic Mines and Collieries.*" The paper being of a general nature, and containing no original matter, need not be abstracted here; but it led to an interesting discussion, from the report of which the following is condensed.

Mr. G. R. Burnell said that the comparative merits of metalliferous mines and coal mines had scarcely been sufficiently dwelt upon. There were conditions affecting the two classes of mines which he thought it desirable for practical men to place before the world somewhat more in detail than had been done at present, so as to get rid of some of the misconception prevalent among the public.

Then, as regarded the question of coal mines, he regretted that Mr. Salmon had not alluded to the great subject which must be present to the minds of all classes—the late sad accident at the Hartley Mine. That accident had naturally excited a great deal of feeling on the part of the public, who, under the inspiration of unpractical writers, were calling out loudly for the adoption of a uniform system of making two shafts to every mine. It was also important in these matters, that the public should be made aware that there was no universal law which could be laid down as rigidly applicable to every case. In the case of the Hartley Mine, there could be no doubt that two shafts would have prevented the fearful loss of life that had occurred, but there were cases—as for instance in the mines near Whitehaven, where the workings were carried under the sea—and where it was impossible to have two shafts. All these cases, therefore, required to be treated upon their special merits, and no universal law could be laid down; and hence arose, in his opinion, the danger of Government interference. The result of Government interference in France had been to destroy the mining industry of the country. Formerly there was a very important mining industry in Brittany—nearly as valuable as that of Cornwall—but at the present day it scarcely existed. In France no man could open a mine without a concession from the Government, and the practical result was, that whilst they were very careful to protect the lives of the people in one way, they would not allow them to gain a living in the other. In his opinion the common sense of the matter, as far as law could interfere for the prevention of accidents, was to make the persons who got the greatest benefit from mining operations responsible in purse and in person for the accidents which might arise. They talked of the impossibility (with a lease of 21 years) of enforcing a proper and costly execution of the work. To his mind that was no excuse, for if the landowner got the benefit,

he ought to be made to pay the consequences of his unjust pressure on the people who took a lease under him. In the case of the Hartley colliery, the accident, as they knew, occurred from the breaking of the large balance beam of the lofty engine. A balance beam of that size ought, in his opinion, never to be made of cast iron, and certainly ought not to be worked over the only shaft of the mine; and therein he thought the engineer was to blame. He did not believe Government inspectors could do much. Inspectors could not lay down laws to suit all cases, and they could not always see that their instructions were carried out. He was sorry to see, by the newspapers of the day, that a Royal Commission had been named. He believed a commission was not the best means of getting at the truth of such matters. The proceedings were conducted with closed doors; the evidence was not necessarily taken down in shorthand, and the whole of the evidence might not be published. He felt that, in all cases of this kind, the most proper tribunal for conducting such an inquiry was a Select Committee of the House of Commons, where everything was done openly and came before the public.

Mr. E. CHADWICK, C.B., said, in respect to Commissioners, the gentleman who had last spoken was wholly misinformed, or informed only by prejudice, as to the procedure, which, when properly conducted, was the reverse of that described. The question between parliamentary committees of enquiry and commissions of inquiry was between inquiries by persons of distracted attention, limited in time to two or three hours a day once or twice a week—persons who were irresponsible, and an inquiry by persons who gave undivided attention from day to day, and who inquired by themselves or their assistants on the spot. On the more immediate topics of the paper, he could only repeat the expression of his conviction on one point, that little progress would be made in mining improvement until the whole cost, the cost in excessive sickness and excessive mortality, as well as the cost of materials in all mining adventures, were charged upon the adventurers or upon the commodity, as it was just they should be. Until the cost of ignorance of the waste and devastation occasioned by recklessness was thrown upon those who used ignorant service, due exertions would not be made to obtain educated labour, as well as superior scientific service. It was an important fact to be borne in mind, that when the causes of accidents were closely inquired into by competent persons, the great majority of them were found to be clearly preventible, the results of empirical management, or grossly ignorant labour. It was true that proprietors suffered from accidents, but not enough; not the whole cost regularly attendant upon them. A large proportion of it was thrown upon others. On the occurrence of calamities from explosive gases, the cause was frequently assigned to the recklessness of the miner, a man who, to light his pipe, would suck the flame through the wire-gauze of the lamp, or poke a hole into the gauze with his pick. The gross ignorance of much of the northern colliery population was matter of general observation. The Cornish miners had a higher degree of education, and their operations were not attended with the same proportion of fatal accidents. A friend, who was highly conversant with mining operations in every part of the country, expressed a confident belief, that had the accident of the Hartley colliery happened to a body of the better-educated Cornish miners, he was quite confident they would have worked their way out, for the distance to be cut through was stated to be not more than thirty feet. Competent inspection of the dangerous processes, combined with the principle of interest in the results, would occasion the inspector to be regarded as an ally, bringing the knowledge, derived from wide observations of experience, in aid of the owners' objects. There was an example in Lancashire of an association of the owners of steam engines, for the prevention of boiler explosions, whose mode of procedure was to engage an inspector of their own to go about and examine their several engines, and report on their defects to the owners of the engines, as well as to the Association.

Mr. P. H. Holland took a different view from that of one of the previous speakers on the subject of Royal Commissions. His own opinion was, that such a tribunal, being for the most part composed of men selected from their practical knowledge of the subject, was the proper one to deal with matters of this kind. His own experience of such bodies enabled him to state that evidence was taken before a commission at greater length, and the witnesses were allowed to explain their views more fully and more deliberately than before committees of the House of Commons. The question of two shafts in all mines was one which doubtless must in a great degree be regulated by local circumstances and conditions; but he thought the Government inspectors ought to have power to order anything which was practically necessary, with a view to the prevention of accidents in mines. As the law stood at present, the inspector might give directions for a thing to be carried out, but he had no power to enforce it. What he would suggest was, that the owner should either be compelled to adopt the practical suggestions of the inspector, or refer the question to impartial arbitration. It was true, that under the present system an arbitration was provided for, but it could not be considered impartial. The owner had the power of nominating five persons, out of whom the Secretary of State selected one to arbitrate between the owner and inspector. The owner would of course take care to nominate five persons holding the same view as himself, and, therefore, so long as the present system of arbitrating on these matters existed, there was little chance of the inspector's office being a practical good. A little amendment of the law would remedy that matter, and he believed would effect a vast deal of good. After an explosion of gas in a mine it was well known that a great number of people were killed, and it was generally assumed that carbonic acid gas was the destructive agent, but that was not always the case. The great cause, no doubt, was the absence of the oxygen of which the air had been deprived by the explosion. and the men were so to speak drowned. But there was another cause of death in mines more frequent than that. There was the effects of dust. This was found to be the case to a considerable extent in the case of the Riscar explosion, by which 140 persons were killed. On examination of the bodies of several of the sufferers, it was found that their mouths were full of coal dust, by which they had been literally choked, and it appeared that others had employed their handkerchiefs, or something of that kind, to keep the dust out of their mouths. Mr. Holland next referred to the subject of the men mounting by ladders, and remarked upon the instances of great physical exhaustion he had witnessed after men had reached the surface from a depth of 300 fathoms and upwards, and he then proceeded to speak of the effects produced upon the health of miners from working in badly ventilated mines. He referred to the great prevalence of consumption among the metallic miners of Cornwall, which he attributed in a great measure to the impurity of the air they breathed, in contrast to the result upon the miners in the north, where the workings were better ventilated. In the better ventilated coal-mines, the deaths from consumption were not generally above the ordinary average of other occupations.

Mr. Wm. Hawes said he believed if there was anything more likely than another to increase difficulties, it would be the admitting direct Government action and interference with mining operations, as would be the case in any other branch of national industry. But they might have a certain amount of inspection over mines, as they had over factories and over the administration of the poor-laws. That the reasonable recommendations of the inspectors, if not attended to, should bring serious results to the owners, was one thing; but to appoint a body of inspectors to whom should be delegated the authority of saying a certain thing must be done, was taking out of the hands of a great industry of this country that power of independent action without which no industry could be successfully worked. Let him apply this to the observations of some of the speakers that evening.

His friend, Mr. Chadwick, had told them that the colliers in the north were the most uneducated class, whilst the workpeople of Cornwall were the most educated class of miners. [Mr. Chadwick—Comparatively.] But the gentlemen who spoke last had told them that, so badly were the Cornish mines ventilated, so ill-provided were they with fresh air, so little interest did the owners take in the lives of their workmen, that the mortality amongst them was higher than amongst the uneducated and ill-provided-for colliers of the North. The contradictions of those two gentlemen indicated to him that they had not proper information on which to decide the question of interference one way or the other, and no man whom they might put upon the commission, unless he has served his time in the North and the West, was fit to deal with the question. Then they had placed before them various forms in which this interference was to take place. They were to have general orders. What did that mean as applied to mines? Then they were to have a tribunal of Inspectors, and an Act of Parliament to be enforced with penalties against the owners. These were other words for crippling an industrial energy, on which depended the mining interests of the country. He was quite of opinion that they could not throw too much responsibility upon men engaged in commerce of any kind; make them responsible for any inattention or wilful neglect, or want of proper care for the lives of the men they employed, and then everything that was required would be done in the best and most economical manner. They might apply the same rule to the managers of mines as was applied to railway directors, who were made responsible out of their own pockets, and the pockets of the shareholders, and they would thus have a direct interest in the prevention of accidents. He (Mr. Hawes), therefore, said, hold the owners responsible for any cases of gross neglect, and there would be greater care to protect their men against accident than would be the case under a system of Government inspection. He would add that he never lost an opportunity which presented itself of protesting against Government interference with trade; and whilst the great accident at the Hartley colliery enlisted the sympathies of the great mass of the people of this country, let them beware that such sympathies did not lead the way to a system of Government interference which would crush the best industrial energies of the nation.

Mr. Warington Smyth, F.R.S., begged to recall the attention of the meeting to the paper of Mr. Salmon, because he thought the object of that paper had been misunderstood. If they had attended more to the varying circumstances which that gentleman had placed before them, in respect of the differing conditions of mines, he thought a very great deal of discussion upon generalities might have been avoided. If that had been done they would not have heard so much said about having more than one shaft to every mine, or the unfair comparisons between the miners of Cornwall and the colliers of the north, if they had kept before them the facts which had been introduced to their notice in the paper. With reference to the numerous shafts in some of the Cornish mines, as mentioned by a preceding speaker, it was to be recollected that many of them were mere drifts, principally undertaken for exploring purposes in metalliferous mines; there was not the certain dead expense which was attendant on the sinking of the main shafts of a coal mine, and it was frequently the case that portions of a shaft more than paid the expenses of the sinking; and Mr. Salmon had pointed attention to the fact that the entire work in a metalliferous mine was a continuous exploration. Therefore they could not look for that perfection of mechanical arrangement which they looked for in collieries, where the great expense of sinking a shaft having been once overcome, the mechanical appliances were of a character best adapted for raising large quantities of mineral with a due amount of profit. The paper embraced so extensive a range of subjects that he thought it was unfair to complain of the want of details, such as had been adverted to by one or

two speakers, and they must also remember that upon those details a great amount of importance was to be placed which could scarcely be measured by having passed before them in review the general tendency of mining operations, the object of the paper being merely to present a comparison of the two methods adopted. But with respect to some of the observations which had fallen, he must say some very strong misapprehensions appeared to be entertained in respect of some of those points: amongst others, that in mines worked beneath the sea they could not conveniently have more than one shaft, and the mines in Whitehaven were instanced as an illustration of this. He would say, having examined those mines officially, they were doubtless worked under difficulties, but were nevertheless admirably ventilated, and, as far as human prudence could foresee, were worked in a very safe and satisfactory manner; and although there might be some inconvenience in carrying a shaft through the sea, there might nevertheless be more than one shaft on the land. There were several other openings in the crop of the measures on the land, whereby the current of air produced was, in the main-air roads, almost enough to blow the spectator along. He might mention that, in Cornwall, there were several submarine mines near the Land's End which were worked under the sea at very considerable depths, and in those cases they were not satisfied with one or two shafts, but they sometimes had half a dozen, far more indeed than would be dictated by a prudent sense of economy, and which had been undertaken principally for the purposes of exploration. The paper had touched upon a great number of interesting topics, and he thought their thanks were due to Mr. Salmon for having placed before them the contrast of conditions under which the two classes of mines were worked. As regarded the last paragraph of the paper, it was an extremely suggestive one. Much might be said for and against governmental inspection. He had witnessed the gradual spread of that system—commencing with two commissioners, then adding two inspectors, who were again increased to six, and these subsequently to twelve, until they had them established in all parts of the coal-mining districts of the country. He believed a considerable amount of good had been effected by those inspectors, not so much by their actually going down into the collieries and personally introducing improvement, but because it was known that they might come at any moment, and many things were put in order with regard to ventilation and mechanical appliances which would have lingered on for years unattended to, if the owners had not had the fear of the inspectors before their eyes. He believed the extent to which the great staple minerals of the country, coal and iron, were worked, made it more important for the nation at large to look carefully into the mode in which these matters were managed. That simple question of the dimensions of the pillars, as compared with the quantity of coal removed, might not only give rise to controversy, but it was one also of considerable national importance. In districts where fuel was of the highest value, there were hundreds of acres of coal entirely destroyed, simply from the fact of those pillars not having been duly proportioned to the space of coal removed, and they could not regard this in any other light than as a national loss; but whether it was possible to introduce a supervision like that on the continent, was another question—nor did he say that he thought it would be desirable to do so. They had heard that evening of the appointment of a Royal Commission to inquire into the metalliferous mines, but he believed, unless great caution was exercised in some of these matters, as much harm as good might be done by the interference of Government, when it was not absolutely necessary. In consequence of the increasing depth and difficulty under which coal mines were worked, he thought it might be advisable that the Government should exercise a supervision to see that the mine was not exposed to danger, and on the other hand that the coal was not improperly wasted. But on the subject of accidents, he

would say, let them be very careful in distinguishing between accidents which might be termed unavoidable, and those which were the consequence of a neglect of due precaution, or the neglect of cautions given. They had confounded the two cases together too much. Cases of explosion from the want of sufficient ventilation, or from the neglect of discipline and the breaking of an iron beam which was believed to be equal to a much greater weight than it had to bear, ought, he thought, to be considered in a very different light, and the latter was amongst those accidents which human foresight could not have avoided; but the objection that had been taken to a cast iron beam, as such, was so preposterous to those who were acquainted with the matter, that he would not waste words on the subject. If they looked at the object of the paper, which was to point out the distinction between the two systems of mining, he thought they ought not to be so hasty to blame, but that something was often to be said in extenuation on account of the many difficulties under which coal-owners laboured; and from the experience he had had amongst the managers of mines, he could say there were very few indeed who were not grieved to the heart when loss of life occurred from accidents, and who did not take every reasonable precaution to guard against such accidents in future.

Professor TENNANT having made a few remarks,

The CHAIRMAN said, with regard to the various points embraced in the subject, if the hour had not been so late he should have been glad to have gone into some of them with a view of making one or two comments—not so much upon the paper itself, as upon some of the remarks which had fallen in the course of the discussion. Much had been said on the subject of commissions. Upon that point he might be allowed to speak with some little authority, having himself acted on a commission upon an important mining affair; and he must say, that that commission, and commissions generally, so far as he was acquainted with them, had been well adapted for obtaining a vast quantity of detail which could not by possibility be brought before a committee of the House of Commons. Then as to the remarks respecting the great importance of minerals, especially coal, that was a point which must be impressed upon the public in every possible way. The increasing depth and difficulty of working mines was such that it would undoubtedly force the subject very much upon public attention. Allusion had naturally been made to that most lamentable calamity at the Hartley New Pit, in Northumberland; and here he would take occasion to say, that although every one now perceived that two shafts would have prevented the fearful results of that accident, yet it was impossible, in the nature of circumstances, that every precaution against such an accident could have been provided against, or its necessity foreseen. Without entering into any details upon the prudence or necessity of a second shaft (for he, no doubt, must admit that if a second means of communication had existed it would have been more prudent) he (Mr. Sopwith) must be permitted to say that the accident, by its extent, and by the singular nature of its occurrence, was removed out of the category of those which were within the ordinary range of foresight. Much had been said about the responsibility of the owners; and here he must observe (and he spoke from an extensive acquaintance with owners and other parties connected with mines) that when an accident had happened, he did not think a greater responsibility could well fall upon them, than that severe loss of property which they suffered, in addition to that severe affliction and heavy grief which weighed them to the earth. They must not call too loudly in such cases for additional punishment. They must take into consideration the situation of those who suffered the ruin of their fortune—who like the rest of their fellowmen felt most acutely the misery and distress such occurrences produced. He would only make one further remark on this subject. It had been said that the poor men might have worked their way out of the mine. Mr.

Coulson, one of the most able and experienced men in this kingdom in the sinking of mines, was unable, with all the skill and energy of the most brave workmen, to work his way *in*; how then could it have been possible for those who were buried under the ruins to work their way *out?* Imagine a castle to have fallen. If those brave men could only move two or three feet, or perhaps as many inches, in as many hours, how was it possible for those who were buried in the cellars and vaults to work through the superincumbent mass of ruins? Many points had been alluded to in the discussion. He did not like the discussion the more because it had wandered a little from the point. He thought that was the object of a paper of this kind—to open out a discussion of the subject in all its bearings, and to obtain the opinion of different classes of minds upon it. He must, however, say a word as to the intelligence of miners in the north as compared with those in the south. Coal mining was for the most part a laborious quarrying operation, whereas working in metallic mines was of a kind to excite thought and reflection, and it was for that reason that they found in metallic mines the workmen really more thoughtful and intelligent. It was stated that in metallic mines the only means of bringing the men out was by rough mechanical contrivances, and that in Cornwall they were bringing them up without the aid of slides. He could say in all the mines under his direction the workmen were brought out of the metallic mines by slides. Mr. Warington Smyth knew that in no mines, whether coal or other, were the miners brought out in a more careful manner, by the aid of the best machinery, than in the mines to which he had just alluded.

A Personal Narrative of the Appalling Catastrophe at Hartley New Pit, January 16th, 1862. By T. Wemyss Reid. (Reprinted from the *Newcastle Daily Journal.)*

We have great pleasure in noticing this narrative of the Hartley accident, which does great credit to Mr. Reid. Any person desirous of having a permanent record of this lamentable catastrophe, and of the heroic efforts made to save the buried men, should at once get this pamphlet, which is published at the *Newcastle Daily Journal* Office, price one shilling. It is dedicated, by permission, to the Duke of Northumberland, and "represents accurately the feeling prevalent upon the spot during the long period of suspense intervening between the occurrence of the accident and the discovery of the fate of those who suffered by it; a feeling which varied every hour, and which can, therefore, only be truthfully recorded by a contemporaneous record."

What is Good Iron, and How is it to be Got? London: John Murray, Albemarle Street.

This is an anonymous pamphlet, but it is evidently written by one well acquainted with the generalities, at least, of the iron-trade. It opens with the question that gives the title to the pamphlet—"What is good iron, and how is it to be got?" To which the author adds—"The conviction is daily gaining ground that by the penny-wise and improvident use of inferior qualities of iron, much capital has of late years been wasted and much risk incurred."

Upon this text he expatiates with considerable force, and in a vigorous and popular style. He explains the deterioration in the quality of the iron which has resulted from the introduction of the hot blast, and above all the use of the cinder as in iron-ore; and shows how the pressure of competition is daily aggravating the evil, Not that he denies the importance of cheap iron for the development of modern civilization, which he admits will be ...nd, for many purposes, to answer as well as the best; but he points out ...his mania for cheapness is gradually driving thoroughly good iron out

of the market, so as to render its being procured, even when required for the most vital purposes, a matter of extreme uncertainty if not difficulty.

"Thus, then, the year 1862 opens with the paradoxical condition of the iron trade, which we have endeavoured to explain by tracing the steps by which it has been reached. No blame is imputed to the manufacturers as a body, who have only obeyed the laws which regulate all commercial transactions. It would be foreign to the purpose to note the struggles of individuals who have held a course in opposition to the current of the times: we have to deal only with general results. On the one hand we see a rapid declension in the use, and therefore in the production of first-class iron; involving a complete change, material and moral, in the iron trade. On the other hand, we find a reaction in favour of the best iron, which, though real, has hardly yet advanced beyond words. The public have discovered that, for certain purposes of great importance, the substitution of cheap iron for good is a failure, but the pressure on the manufacturers is not yet sufficiently strong to divert them from the policy and practice of years; and hence it is that, amidst all the talk about first-class iron, the demand for it has not increased. This circumstance is favourable at least to those who desire to be purchasers. But it is scarcely possible that Government should avail itself of the opportunity. No Government can act with the energy and decision of an individual trader. It lacks central motive power. It is a huge giant, rendered helpless by the feeble and defective action of the heart. The question is not only, What ought Government to do? but, How much can it do of what it ought?"

How the author proposes that these difficulties may be met, particularly in the case of iron intended for Government use and the national defences, we must refer those interested in the subject to the pamphlet itself.

The "Journal of the Chemical Society" is now published monthly, instead of quarterly as hitherto. The January number contains two papers by Professor Bolley, which may be of interest to our readers: the first is, *On some Physical Properties of the Alloys of Tin and Lead;* and the second describes some *New Experiments on the Dangers arising from the use of Certain Waters for feeding Steam Boilers.* The first paper is of considerable interest; but as it will scarcely bear condensation or abstraction, we must refer our readers interested in the subject to the "Journal" itself. The second is of more immediate practical importance, as it indicates a source of danger to steam-boilers not before suspected. Hitherto the danger of deposits from the feed-water of steam-boilers was supposed to be confined to *sulphates* of lime, &c., which form a stony incrustation; *carbonates,* which afford only a pulverulent or muddy deposit, not being observed to create any inconvenience. In consequence of numerous disturbances to certain boilers at Zurich in Switzerland, samples of the feed-water were sent to the Professor for examination, which he found to contain principally carbonate of lime, *sulphate being entirely absent.* This absence of what had been considered as the main source of danger, while accidents were of frequent occurrence from the use of water containing chiefly carbonates hitherto deemed innocuous, naturally led to careful enquiries. The result of these, which are given in this paper, show that the evil was due to the presence of a certain proportion of *fatty* matter. The effect of the combination of this fatty matter with the carbonate of lime was to form in the boiler a grey pulverulent deposit *which swam on the surface of the water and did not become wet.* This deposit, which was thus kept floating, completely covered the heated surface of the flue, so as to prevent the water coming in contact with it. The original source of this fatty matter does not seem to have been ascertained with certainty, but its presence was probably owing to the water supplied to the boiler being taken from the condenser of another engine. The evil was remedied, on the advice of the professor, by the

addition of a small quantity of *carbonate of soda*, which combined with the fatty matter to form an alkaline liquid; the result being that the pulverulent carbonate, thus freed from these fatty matters, were at length thrown down. We think there can be no doubt that the investigations recorded in this paper are of considerable practical value, for they point out a source of danger not hitherto suspected, and certainly show the necessity of great care in endeavouring to avoid, as much as possible, supplying boilers with water likely to contain fatty matters even in very small quantities—such, for instance, as they might take up by being used for condensing.

The following is from the *Times* City Article of the 26th February. It is difficult, at the moment, to foresee the effects of this extraordinary production of mineral oil, but it certainly threatens to revolutionise certain branches of industry.

The production of oil from the springs in Canada and the United States continues on a scale far greater than the means of transport. At present the refining trade as regards this product seems in a state of only partial organization, and the difficulties and cost of conveyance delay its development. Every fresh account, however, seems to indicate that the supply is virtually illimitable, and that the result will be the growth of a new business, which, for rapidity and extent, will be such as has rarely been paralleled in the history of commercial changes. Hitherto the arrivals in Europe have not been large; but a vessel has just discharged 5,000 barrels in Victoria Dock, and several additional cargoes are daily expected, both here and at Liverpool. The New England houses are gradually withdrawing themselves from the sperm oil trade, with the view of investing their capital in the establishment of refineries (a change in which they have been assisted by the opportunity of selling some of their old vessels to the Government for the stone blockade at Charleston) and they now appear to have commenced making consignments, especially from Boston, with some degree of regularity. To check this competition the Paraffine patent owners in the United Kingdom have commenced a suit in Chancery to prevent the use of that name for the American manufacture. The article, however, must be wholly independent of the name under which it is offered, and will find its market solely according to its claims on the score of quality and cheapness. An increase of purity is being constantly effected by the daily experience from its enlarged manufacture, but the question of price cannot be tested until the requisite facilities of transport shall have been established. The prime cost at present is actually almost nominal, but there are 30 miles of bad roads to be traversed before the oil can be placed on the railway either for New York or Boston, and the expenses and difficulties of cartage are enormous. The hardening of the roads by a sharp frost will occasionally make all the difference between very large profits or a direct loss to the wellowners. Lately, the oil has been sold at the wells for a sum equal to 1s. per barrel, and an instance is mentioned of a lot of several hundred barrels having been disposed of at 11s., barrels included. Under such circumstances it is only the wells that flow spontaneously to the surface that can be worked at a profit; but these yield a seemingly inexhaustible quantity. In the course of less than half a year, however, direct railway communication, both in Canada and Pennsylvania, will, it is said, be established into the heart of the principal regions. In Canada the directors of the Great Western line are directing their attention to the requisite measures, and in Pennsylvania an extension of the Atlantic and Great Western line, which connects with the Erie Railway to New York, is stated to have been already commenced to the principal seat of the business, with the certainty of completion in the course of the ensuing spring. Meanwhile the entire district, which a few years back was little more than a wilderness, is becoming thickly peopled, notwithstanding the interference of the war

with commercial operations of all kinds. The following are the latest particulars given in the Philadelphia journals :—

"The coal oil of Pennsylvania is rapidly becoming one of the important elements of our industry and wealth. It is scarcely three years old, and even now it bids fair to rival the coal trade itself. The following statement of the shipments on the Philadelphia and Erie Railroad alone will give a comparative idea of the increase of this trade :—In 1859, 325 barrels; in 1860, 21,794 barrels; in 1861, 134,927 barrels; while for the first month of 1862 the total shipments on this road have been estimated at 30,000 barrels. Large as the business and the increase on this railroad has been, it is estimated that it shows but little more than one-sixth of the business actually done. Large quantities of the oil were taken to Pittsburg by way of the Alleghany River, and thence to Philadelphia by the Pennsylvania Railroad. The Erie Extension Canal carried large quantities to Erie, whence it found its way to the Eastern market by the lake and the railroads in North-western Pennsylvania. It is stated on good authority that the well on Oil Creek yields 75,000 barrels of crude oil per month, which would be 900,000 per annum. What the yield of the whole oil region in this State will be during the present year cannot be definitely ascertained, but it must reach very considerably over a million barrels of crude oil, for new wells are continually being opened, and the trade is making the most astonishing strides, and promises greater wonders still. It has no parallel in this country or in the world, except the Californian gold fever, which it rivals in speculation and excitement. The crude oil, it is said, involves an expense of about $10 per barrel in purchasing barrels, transportation, refining, &c., so that the actual expenditure on 1,000,000 of barrels would be $10,000,000 per annum. The region of country in which such immense wealth is now being developed was, before the excitement caused by 'striking oil,' comparatively thinly populated, and much of it a wilderness, but now it is becoming thickly settled, and new towns are springing up, and old ones growing into greater proportions. This will make that section one of the most flourishing in the commonwealth, while all the oil seeking an Eastern market and an outlet for Europe must greatly benefit and increase the trade of Philadelphia, the emporium of the State."

Notes, Queries and Correspondence.

[We need scarcely say that we cannot hold ourselves responsible for the facts or opinions of our correspondents; although we shall make it a point to endeavour to exclude those who are obviously inaccurate or fallacious, as far as is consistent with our wish to encourage the freest discussion.]

NAPIER'S COPPER-SMELTING PROCESS.

Sir,—Permit me to reply in few words to a letter in your last number signed "An Old Copper Smelter." The author of that letter is neither so old in years, nor so experienced in the art of copper-smelting, as his *nom de plume* would lead us to infer. The dates of his birth and death in the copper-smelting world are well known; and the period comprised between these events was too short to justify the assumption on his part of the title "Old Copper Smelter." It is obvious that he has an almost *parental* affection for Napier's process; and therefore any judgment which he may pronounce in its favour must be received with that caution which, in his letter, he properly declares to be necessary in the case of "interested statements."

The "Old Copper Smelter" asserts that "on some of the practical parts, particularly in reference to the smelting of the ore, it (my work on Metallurgy) is defective, and shows, more than anything can, that if metallurgy is to be studied properly, it must be done at the works, where the practical operations are conducted." Now the particular part of the work here referred to was revised in type by one of the best educated and most experienced smelters in the kingdom.

The "Old Copper Smelter," under the protection of his anonymous signature, ventures to intimate that I am wilfully blind to the merits of Napier's process, and have allowed my judgment respecting it to be influenced by personal considerations. I have only to observe in reply that the man who thus imputes unworthy motives to others will generally be found to deserve the imputation himself.

The complaint of the use of "*sic*" is perfectly just; and I much regret that I should have been guilty of verbal inaccuracy in the quotation. I have inadvertently omitted the words, "samples taken out and," which should immediately precede the word "tried."

I am accused of unfairness in my remarks on Napier's experiments upon the calcination of the charge of Cuba ore. My reasoning is based on Mr. Napier's own analytical data, and if my conclusions be erroneous I should be glad to see them disproved.

Whether Napier's process should be regarded as a success or a failure, your readers will be enabled to judge from the admissions contained in the letter of the "Old Copper Smelter." It is certain that the copper smelters have not yet become convinced of its value, for otherwise they would not have allowed Mr. Napier recently to obtain an extension of his patent without opposition. Mr. Napier would, if I mistake not, be the first to admit that a metallurgical process cannot, in many cases at least, be satisfactorily tested by experiments in a laboratory, as it is often impossible to fulfil conditions on a large scale which may be easily secured on a small scale. A chemist, therefore, who should pronounce from experiments in crucibles that tin, antimony, and arsenic might be completely separated from copper ore by Napier's process, in furnace operations on a large scale, would assuredly be guilty of imprudence. I have confessed my doubts as to the precise causes which led to the discontinuance of Napier's process; the balance-sheets of the establishment would probably afford a satisfactory explanation. It is alleged that I am in error in stating that Napier's process at the Spitty works was replaced by the ancient method of copper-smelting. The manager of the works personally informed me that such was the fact; but I may have misunderstood him. However this may be, the really important fact remains:—Napier's process was abandoned.

In publishing the report concerning the alleged excess of copper on the furnace bottoms at the Spitty works, it was not my intention to convey the impression that this was especially due to Napier's process, and I regret that I could have been misinterpreted on this point. My object was simply to shew that estimates in such cases are to a great extent guesswork, and ought never to be received with implicit confidence. I know one of the persons who was engaged in making the estimate: he is a most experienced smelter, and an honourable man,—a man quite incapable of falsifying an estimate from unworthy motives, as the "Old Copper Smelter" insinuates.

The "Old Copper Smelter," would act wisely in future not to judge others by himself, and impute motives which have no foundation except in his own imagination.

I remain, Sir,
Your obedient servant,
JOHN PERCY.

School of Mines,
February, 1862.

OXLAND'S PROCESS.

SIR,—In the interesting account contained in your first number, of Oxland's process of separating wolfram from tin, the chief agent employed is stated to be "*soda-ash.*" If this is not an error, I must certainly agree with your correspondent "Chemist" in readily accounting for a loss of tin

in the form of stannate of soda. Oxland's process, as it is described in Bruno Kerl's Metallurgie (for I have not at hand his patent specification), is accomplished by means of salt cake (*sulphate* of soda), and should give very different results.

A mixture of wolfram and tin oxides, fused with sulphate of soda, or better, bi-sulphate of soda, would give a soluble tungstate of soda, which might be extracted with hot water, leaving oxide of tin unsoluble. Kerl's description is as follows:—

Sulphate of soda and coal slack is added to the tin witts in fine grain, and thinly spread out on the hearth in proportion, according to the per centage of wolfram. The mixture is at first heated with a smoky (reducing) flame, then with a strong oxidizing flame, in a reverberatory furnace with an iron bed. Tungstate of soda is formed, and sulphur and iron separated the tin stone remains undecomposed. The charge is then exhausted with hot water, and freed from the tungstate of soda, which is utilized in certain chemical establishments; the rest is washed to free it from oxide of iron.

These re-actions are confirmed also by H. Rose, in his work on Analytical Chemistry, and would, I believe, give much more satisfactory results than the process which with soda-ash produces *two* soluble salts.

Yours truly,

WILLIAM BAKER.

It is curious to remark the traces of the Germans in our smelting and mining works. The word "tin witts" was new to me, but I recognize it in the Zinnzwitter used to denote a mixture of tin stone and other minerals: Zwitter=hermaphrodite (mongrel).

W.B.

Lead Works, Sheffield, February 7th, 1862.

THE GREAT WHIN SILL.

DEAR SIR,—As I observe, in the January number of the Mining and Smelting Magazine, that you intend opening a department of Notes, Queries, and Correspondence, I therefore beg the privilege of asking for opinions relative to the following queries:—

1. Has the Great Whin Sill of the North of England been spread over the area which it now occupies by submarine lava currents?

2. How, or in what manner, was it likely that the molten matter would find its way through the solid crust?

3. From what point, or points, on the area of the lead-mining district was it erupted?

Replies to the above will much oblige,

Your very obedient Servant,

JOHN CURRY.

Feb. 22nd, 1862.

Mining, Quarrying, and Metallurgical Intelligence.

CORNWALL AND DEVON.

In the *Gazette* of the 18th of February, it was announced that the Queen had been pleased to appoint the Right Hon. Lord Kinnaird, K.T., the Hon. Fulke Egerton, Nicholas Kendall, Esq., Henry Austin Bruce, Esq., John St. Aubyn, Esq., John Davie Furguson Davie, Esq., Edward Headlam Greenhow, M. D., and Philip Henry Holland, Esq., to be her Majesty's commissioners to enquire into the condition of all mines in Great Britain, to which the provisions of the Act 23 and 24 Vic., c. 151, do not apply, with reference to the health and safety of persons employed in such mines.

The appointment of this commission, to enquire into the condition of the metallic mines of Great Britain, has been for some time expected, and consequently its nomination excites no surprise. Its composition is no doubt very fair; and the metallic mining interests of the country may, we are assured, anticipate an impartial and unprejudiced enquiry at its hands. At the same time it may be well to remind those interested in metallic mines that this commission must arrive at its conclusions *from the evidence placed before it;* and that consequently they must bestir themselves so as to bring forward the real facts, and not to allow one side only to be heard. It is no doubt true that mining is not the most healthy pursuit a man can follow; but we are quite satisfied that its unhealthiness has been enormously exaggerated by certain well-meaning, but fussy and half-informed people. It is the duty of those most interested in mining to take care that this class of busy-bodies does not manage to gain exclusively the ear of the commission, and make it merely a medium of giving an official stamp to their theories.

Certain figures regarding the rate of mortality among metallic miners have for some years been freely circulated among the public. Those acquainted with the subject are aware that these figures do not represent *facts* but *theories*. It is notorious that an ingenious man can prove any thing by figures, by selecting those that suit him, and suppressing those that do not —the process followed in this case. We have much pleasure in noticing the following letter on this subject, in the *West Briton*, from Captain Charles Thomas, of Dolcoath.

"Much having been recently said and written on the diseases and the length of the lives of Cornish miners, the attention of thoughtful men has been directed to the consideration of that very important subject.

"Your readers will at once admit that it is essential to the arriving at truth, in this as in any other matter, that sufficient data should be obtained. in order to which I beg to suggest the propriety, indeed the necessity, of having answers to the following questions:—

"Firstly. The number of persons working underground, with their ages, in any district comprising several mines.

"Secondly. The number and ages of those who did work underground, and who are now employed as mine agents, pitmen, timbermen, enginemen, and other engagements on the surface of the mines in the same district.

"Thirdly. The number and the ages of those who formerly worked underground in that district, who are now engaged in some business, keeping small shops, cultivating small farms, &c.

"Fourthly. The number and ages of those still living who have emigrated to our colonies, or to foreign lands within the last 20 years, and of those who have returned from fields of successful enterprise.

"I doubt if any class of labourers on the earth has so large a proportion as the Cornish miners who move out of the sphere they have been trained in, to occupy improved positions in society, and by emigrating to endeavour to benefit themselves and their families.

"If this important matter be fairly looked at in the light which can be had in the way indicated above, I am inclined to think the average length of the lives of miners in the Camborne district, and in some others also, would be found to be little short of 40 years, instead of 30, as given by some who have only taken a partial view of the matter."

The testimony of such an experienced, and at the same time such a candid and impartial man as Captain Charles Thomas, that the average of life among miners is 25 per cent. greater than is stated to be the case by those who take "a partial view of the matter," shows, at least, how uncertain our knowledge is at present. The enquiries of this newly-appointed commission, if conducted judiciously, and if aided by those best able to afford authentic information, ought to give us conclusions on which at least we can rely.

In the WENDRON tin district, mining is progressing steadily, although without any very striking features. At *Wendron Consols* the mine is generally looking very well; and now that the heavy dead works, recently carried out, are completed, a resumption of dividends may be speedily expected. At Hills, the shaft is sinking below the 80, by 6 men. At Bal Dees, 9 men are sinking below the 35, and in a short time it is hoped that this important part of the mine will be opened up; the new engine, which has been recently erected here, works exceedingly well. At Bishops, the shaft is sinking below the 52, by 6 men; the lode is improved, and this part of the mine generally looks well. At Wheal Fat, the shaft is sinking below the 15, on a large lode; this part of the mine is very promising, and looks likely to open out well. In the 15 driving west on Wheal Fat lode, tin is expected when this lode makes a junction with Richard's lode, about 20 fathoms further west.

The adjoining mine, *Wheal Basset and Grylls*, looks extremely well. The 32 is being driven east and west on Wheal Fat lode, in a large and good lode; but the 16 and 23 ends here, on the Caunter lode, are driven to Wendron Consols boundary, where the lode is large, with a kindly appearance. At Wilkins, the lode is improved, and when this is cut at Tyackes, there is every reason to expect something good will be met with.

At *Wendron United* the new south lode is 3 feet wide at the 30, and is opening out very fair. This is very acceptable, and indeed may be the salvation of the mine. *Garlidna* has been very expensive at surface; if money is now spent underground, the mine will doubtless do by and by. *Trevennen and Tremenhere* is poor, and likewise *North Trumpet*. *Treworlis* is also poor, but a good stone of ore has been lately cut.

Although, as will appear from the above, the Wendron district is not at present flourishing in any very brilliant manner, there can be no doubt whatever that, with sound practical and economical management,—management acquainted with the district,—combined with a good price for tin, it will become one of the most productive in the county for tin.

The continued fall in the standard of copper ore during the last month has naturally created rather a gloomy feeling throughout the county. The deep mines of West Cornwall are so dependent on a high price for their ores, that a continued fall must seriously affect those that are the greatest employers of labour. Every one seems to have decided that, until the American affair is settled somehow, a revival of trade and consequently an advance in the prices of metal is not to be expected. We fear this is the case; but it is to be hoped that the desired time is not so far off as it may seem at present.

WALES AND THE BORDERS.

FLINTSHIRE.—A melancholy accident, which has resulted in the loss of sixteen lives, occurred at Bryn Gwiog Mine, on the Halkyn Mountain, near Mold, Flintshire, on Wednesday, February 12th, between 9 and 10 o'clock in the morning; the men, to the number of 27, were at work as usual, when a sudden in-burst of water took place, which rapidly filled the mine to the upper levels. The source of this water is not at present positively ascertained; but it is supposed to have come from some old workings which were cut into at the bottom of the level. There was no suspicion of there being any workings at such a depth, and consequently no precautions which could have been taken would have availed to prevent the lamentable catastrophe. As the matter is at present under investigation we shall say no more on it until the result of the inquest is known. A subscription, which has now reached £1,000, has been liberally contributed by all the leading local gentry and miners. The Marquis of Westminster contributes £100, and the Bryn Gwiog shareholders £200. It has been stated in some of the papers that the water cut here was that of the old Hendre mine, formerly one of the richest mines in the North Wales district; but such is not the case. The Hendre mine is nearly a mile away, and the surface there is much lower than the bottom of Bryn Gwiog, so the water would have to run up hill to reach the latter mine.

SOUTH WALES.—The official returns of the export of iron and coal at the port of Cardiff, for the month of January, have just been published. As compared with the corresponding months both of 1861 and 1860, there is a considerable decrease. The exports are as follows:—

	1860.		1861.		1862.
Coal......	94,887	...	101,747	...	101,024
Iron......	8,617	...	10,223	...	8,416

The following are the returns of the over-sea shipment of coals from the ports in this district during the month of January:—

Cardiff.—101,024 tons of coal, and 310 tons of coke, in 90 British and 190 foreign bottoms; corresponding month of 1861, 45 British and 239 foreign ships carried 101,747 tons of coal, and 601 tons of coke.

Swansea.—41,316 tons of coal, carried in 53 British and 149 foreign craft; in the corresponding month, 27,832 tons of coals, 70 tons of coke, were exported in 29 British and 107 foreign ships.

Newport.—16,875 tons of coal, in 13 British and 22 foreign ships; corresponding month, 20,160 tons of coal, in 16 British and 31 foreign vessels.

Llanelly.—9,546 tons of coal, in 25 British and 29 foreign ships; in the corresponding period last year, 24 British and 31 foreign vessels conveyed over-sea 8,325 tons of coal, and 620 tons of coke.

A terrible explosion occurred on Wednesday, the 19th February, at the Cethin Colliery, near Merther Tidvil, the property of Mr. William Crawshay, by which 47 men were killed. The cause of the explosion has not yet been ascertained, but it is being rigidly investigated by the Government Inspector, Mr. Evans. It is supposed to have been caused by a "blower" of gas, and, on all hands, it seems to be admitted to have been an unavoidable accident, for the pit was thoroughly well ventilated, and was generally held to be a tolerably safe one. An explosion occurred in the same pit about 10 years ago, but then, fortunately, without loss of life. Of the 47 who perished, 21 died from burns, and 26 from suffocation by choke damp. The investigation of this explosion may throw some light on the vexed question of sudden outbursts of gas, which has been recently so keenly debated, particularly at the Geological Society of Manchester.

NORTHERN COUNTIES.

The Hartley catastrophe has absorbed all attention in this district for the last month. The verdict of the jury and the result of the enquiry are too well known in every corner of the kingdom to require recapitulation. As to the immediate cause of the accident, the breaking of the beam, this was undoubtedly brought about by the breaking of the pump "spear" or "rod," in consequence of the bucket getting fast in the pump just as the engine commenced to make her strike. Hence the *original* cause of the accident was a defect in the pit-work. How the breaking of the "spear" led to the breakage of the beam is involved in considerable obscurity; but it seems that when the spear broke, the beam sprang in with terrific force, breaking in the concussion. That under such circumstances the beam, if of proper construction and placement, should not have broken, is quite clear. But it seems to have been originally badly proportioned, having too much metal about the centre; and besides, the gudgeons seem to have been keyed too tight. Still the beam, notwithstanding these deficiencies, might have borne the shock of it, had it not been for the frosty weather, which had affected the iron.

The secondary cause of the lamentable loss of life accompanying this accident—the absence of a second shaft—has more impressed itself upon the public mind. In the foregoing pages of this number, our readers will have the opportunity of reading the various opinions expressed on this subject, by competent persons, at the discussions of the Society of Arts and the Geological Society of Manchester.

One of the numerous issues arising out of an occurrence which has so moved the public mind, is the notion which has sprung up of making employers pecuniarily responsible to their workmen for accidents. This has found a tangible expression in the Bill which Mr. Ayrton has brought before the House of Commons. A recent number of the *Colliery Guardian* has an admirable article on this subject, which we make no apology for reprinting, particularly as we are satisfied, from certain statements made at the meeting of the Society of Arts, on the 19th ult., that the question is far from being generally understood.

The bill introduced into the House of Commons by Mr. Ayrton, to "amend the law relating to the recovery of damages by workmen and servants, and of compensation by the families of workmen and servants killed by accidents," is remarkably brief, and is also remarkably comprehensive, for, if sanctioned by the legislature, it will very materially increase the responsibilities of all classes of employers. As the law now stands, employers are bound to provide suitable and sufficient machinery, apparatus, or tackle for the proper and safe carrying on of the works they have undertaken, and if any servant shall suffer injury while engaged in his proper vocation through the imperfection or inadequacy of the apparatus provided for him, the employer is liable for damages, and if the servant shall have been killed his representative is entitled to compensation. This is reasonable and just, for, as the employer undertakes to provide proper machinery or tackle, and the servant accepts his position on this implied condition, the arrangement is equitable, and both parties should be bound to fulfil their several parts of the contract. Further than this, an employer is responsible for the actions of his servant so far as they spring out of the performance of his duties, and as they affect extraneous parties. Thus, if a boatman run his boat against another through carelessness, and thereby cause serious damage to that other boat, the employer of the boatman is in the first place responsible for the damage sustained. A master, however, is not answerable for the wilful acts of his workman, nor for any acts done beyond the scope of his employment. Neither is he responsible for injuries sustained by one servant through the misconduct or negligence of another servant. These principles are of so much importance at the present time that it may be expedient to explain them more fully, and with the aid of higher legal authority than we can bring to bear on the subject. Mr. Fowler, in his admirable work on "Collieries and Colliers," explains with remarkable brevity and clearness the law bearing on the responsibility of employers for injuries sustained by their servants. He says that if the negligence or unskilfulness of the

employer himself causes an injury to a person engaged in the business, the former is responsible for such consequences. It is also established that a master is liable to third persons for any injury or damage through the negligence or unskilfulness of a servant acting in his master's employ. The reason for this is, that every act which is done by a servant in the course of his duty is regarded as done by his master's orders, and consequently is the same as if it were the master's own act. He is also bound to take all reasonable precautions for the safety of his servants. Thus, if hidden and secret dangers exist upon his premises, known to him and unknown to his workmen, it is his duty to disclose them to the latter, that they may take precautions for their own safety, and if he neglect to do so he is responsible for any injury they may sustain through their ignorance. This rule implies an obligation on the part of the employer to exercise due vigilance, either himself or through competent servants, for the purpose of detecting any unsoundness or imperfection in the machinery or apparatus employed by him. A colliery owner would be culpable if he induced any man to go down his pit under the persuasion that the rope and other parts of the winding tackle were safe, when he himself knew, or had reasonable ground for believing, that they were dangerous. We are not aware that there is any specific provision requiring the master to employ competent persons as subordinate officials, but from the general tenor of the law there can be no doubt that if in any case it could be proved that a servant had sustained personal injury through the incompetence of a superior servant who was authorised to direct him, damages would be obtained in one of the superior courts. Here, however, the responsibility of the employer stops. It has recently been decided more than once, by the very highest authority, that a master is not responsible for injuries to one fellow-servant caused by the negligence of another fellow-servant in his employ. In the celebrated Barton's Hill case, which was taken to the House of Lords, this principle was affirmed. Lord Cranworth, in giving judgment, spoke of the responsibility of employers for injuries done to third parties, and then proceeded to ask whether the same principle applied to the case of a workman injured by the want of care of a fellow-workman engaged in the same work. His Lordship decided in the negative. When, said he, the workman contracts to do work of any particular sort, he knows, or ought to know, to what risk he is exposing himself, and among the perils he has to encounter are those arising from want of care or judgment on the part of his fellow-workmen. As these cannot be averted by any precaution that his employer can adopt, he deliberately accepts the risk in consideration of the wages he has to receive. In the case of "Griffiths *v.* Gidlow" the same principle was upheld, and the decision was to the effect that as the injury sustained by the plaintiff had not arisen through any fault of the employer, but through the negligence of a fellow servant, the defendant was not responsible. Indeed, when we carefully consider the matter, it is somewhat surprising that any litigation should have arisen for the purpose of fixing upon employers the responsibility of accidents to workmen arising from the negligence or misconduct of their fellow workmen, for the principles of English law, as applicable to this question, are the principles of common sense and justice. If workmen are to be treated, not as children needing constant protection, but as rational men, able to make bargains for themselves, they ought to abide by any arrangement which they deliberately accept. In a contract of service between a colliery owner and a hewer, the former undertakes to safely convey the latter to and from the surface and the bottom of the shaft by providing adequate winding tackle; he also undertakes to keep the mine in a proper state of ventilation so far as may be practicable, and also to employ suitable and competent men as officials. On the other hand, the working collier, knowing the risks of his vocation, accepts them on condition of his receiving the wages usually paid in the district. If any accident should accrue to him through insufficient or unsound tackle, or through bad management of the mine, the employer is responsible, and may be amerced in commensurate damages; but on the other hand, he and his fellow workmen are to a certain extent independent of their employer. They are subject to general and special rules, which the law has undertaken to enforce, but if any of them so misconduct themselves as to injure their fellow servants, they must all abide the consequences without reference to the employer, who, as he had nothing to do with producing the disaster, cannot fairly be charged with any responsibility connected therewith.

Such is the law as it now stands, but Mr. Ayrton, sustained by Lord Robert Montagu, proposes that hereafter whenever any workman or servant shall be injured in consequence of his master, or any other person employed by his master, not doing

any act or providing anything which may be requisite or proper, or doing any act or providing anything that may be improper in connection with the business in which that unfortunate servant has been engaged, then the master shall be liable to damages for the injury, and may be sued for the same by an action at law. In the case of the death of any workman or servant through neglect or default, the same person who would have been liable to action for damages shall be liable to an action for compensation. The scope of this benevolent scheme will be readily understood by supposing it applied to a few cases familiar in their main characteristics to all concerned in the working of collieries. Some years ago there occurred a fearful explosion at the Ince Hall Colliery, near Wigan, through which more than a hundred workmen lost their lives. The verdict, at the conclusion of the inquest, declared that there had been an outpouring of gas at a certain part of the mine, which was defined within very narrow limits, and that the gas must have been ignited through the incautious use of a naked light by the workman employed there. Had Mr. Ayrton's law been in force then, the unfortunate proprietors would have been liable to an action for compensation from the representatives of each of the deceased, and had such actions been raised, strong evidence would have been adduced to prove that the explosion was caused through the negligence or misconduct of a fellow workman. Hundreds of lives are lost every year through want of sufficient propping, and it very often happens that one man's life is sacrificed through the negligence of another who may be working in the same place, and if Mr. Ayrton's bill were to become law multitudes of cases would arise of colliery owners being charged with the responsibility of deaths accruing under such circumstances. Sometimes it happens that colliers when ascending the shaft are drawn up to the pulleys and thrown out of the baskets or tubs, all through the negligence of the engine tenter,—colliery owners would be liable to damages in these cases, though nobody can suppose them to be morally accountable for casualties arising under such circumstances. Boiler explosions may generally be traced either to imperfect materials or the bad management of the persons charged with the duty of attending to the boilers; but by the proposed law the owners of the boilers would be liable to actions for damages or compensation for the injury sustained thereby. We might go through a complete list of the causes of colliery accidents, and find in each an illustration of the way in which the new bill, if it became law, would affect the interests of colliery owners. Be it also noted, that damages are to accrue not only from death but from injuries, and any man who is acquainted with the working of a colliery will at once apprehend what a boundless field would be opened for vexatious litigation and ruinous expense. When an accident occurs to an excursion train, and a number of people are slightly, though perhaps few are dangerously hurt, it is the business of the railway company's local manager to visit all the sufferers as quickly as possible, and arrange the terms of compensation. Delay in such a case is dangerous, for in every district there are benevolent attorneys ready to espouse the cause of the injured without any prospect of payment beyond what is to be derived from the consciousness of vindicating the poor and the hope of participating in damages. The application to collieries of any such law as that relating to compensation for railway accidents would create endless quarrels and confusion, and eventually close one-half the collieries in the kingdom.

It must not be imagined that the benevolent project of Mr. Ayrton will affect the interests only of colliery owners, for there are very few employers in any of the great branches of industry who would not be victimised by its provisions. The case of shipowners will afford as striking an illustration of its injustice and folly as that of colliery owners. Ships are very often wrecked through the negligence, the incompetence, or the mistakes of either captains or their subordinates, and if shipowners were to be mulcted in compensation by the surviving relatives of the crews, who had been lost through misfortune or misadventure, they would soon find themselves sorely beset with claims arising out of such casualties. In other trades the effect of the law might not be so flagrant, but the injustice perpetrated would be palpable and revolting. It is, therefore, incumbent on all employers to adopt prompt and effectual means for preventing its receiving the sanction of the legislature. Like many other foolish and pernicious schemes, it is pushed forward under the pretext of philanthropy, and no doubt its promoters will secure some degree of respect and attention from the House of Commons, by representing it as merely an extension of a principle acknowledged in other cases to the protection of the working classes. Its real effect, so far as they are concerned, would be to contract their sources of subsistence by preventing the investment of capital in undertakings such as are at

once hazardous to property and perilous to life. We need not, however, dwell on this point, for the sketch we have given of the actual state of the law proves that the legislature has taken all reasonable precautions within the scope of its jurisdiction for the prevention of accidents to workmen through the parsimony or heedlessness of employers. The scheme now proposed is one of a series of measures, the total effect of which would be to virtually confiscate a large amount of the capital invested in collieries and other analogous undertakings. We believe its only chance of success will spring from a misconception of its real import, and, therefore, we trust that all who comprehend its true character will be at once energetic and vigilant, and thereby procure its prompt and summary rejection.

Mining, Quarrying, and Smelting Accounts and Meetings.

CORNWALL AND DEVON.

At Great Wheal Fortune (Jan. 22), a dividend of 10*s.* per share was declared, and a balance of upwards of £900 in favour of adventurers carried to next account. The report of the agents was an exceedingly satisfactory one.

At the Alfred Consols Mine (Jan. 27), the accounts for September and October showed—Balance last audit, £279. 11*s.* 2*d.*; mine cost, merchants' bills, and sundries, £1,891. 7*s.* 10*d.*=£2,170. 19*s.*—Copper ore sold, £1,495. 8*s.* 8*d.*: leaving a debit balance of £675. 10*s.* 4*d.*

In consequence of the notice given by the Great Wheal Alfred adventurers to the lords, offering them the materials and the mine, that mine will, most probably, soon cease to work; it is, therefore, resolved that when the result of the answer from the lords be ascertained, that Great Wheal Alfred is certainly condemned, the committee be requested to call a special meeting of the adventurers in this mine, to determine on the future working, and to fill up the vacancies at present in that body. The purser was instructed to take legal proceedings against all in arrear of calls.

At South Caradon Mine (Jan 28—Mr. R. Kittow in the chair), the accounts for the two months ending October showed—Balance last audit, £3,040. 3*s.* 6*d.*; copper ore sold, £9,122. 12*s.* 5*d.*=£12,162. 15*s.* 11*d.*—Mine cost, merchants' bills, and sundries, September, £3,135. 14*s.* 4*d.*; October, £3,186. 2*s.* 5*d.*; leaving credit balance, £5,840. 19*s.* 2*d.* The profit on the two months' working was £2,800. 15*s.* 8*d.* A dividend, and bonus together £2,560 (£5 per share) were declared, and £3,280. 19*s.* 2*d.* carried to credit of next accuont. Captain Peter Clymo reported—"The new discovery alluded to in my last report has failed, the lode at present being unproductive, but still a very promising one, and I think we must go deeper before we have much ore. This level is called the 100, but it is not, in fact, so deep as the East Caradon 50-fm. level. The other parts of the mine are still looking very well, with every probability of a continuance."

At Craddock Moor Mine (Jan. 28), the accounts for September and October showed—Balance last audit, £1,584. 11*s.* 1*d.*; copper ores sold and carriage, £2,420. 1*s.* 4*d.*=£4,004. 12*s.* 5*d.*—Mine cost, merchants' bills, and sundries, £1,926. 17*s.* 9*d.*; November dividend, £369. 5*s.*: leaving credit balance, £1,708. 9*s.* 8*d.* The profit on the two months' working was £493. 3*s.* 7*d.* A dividend of £369. 5*s.* (7*s.* per share) was declared. Capts. H. and J. Taylor and Phillips reported on the points of operation. They estimate to sell 300 tons of usual quality copper ore in the next two months.

At East Wheal Basset (Jan. 28), the accounts showed—Balance last audit, £1,155. 19*s.* 2*d.*; ore sold, &c., £2,482. 2*s.*=£3,638. 1*s.* 2*d.*—Mine cost, merchants' bills, and sundries, £1,156. 16*s.* 4*d.*: leaving credit balance, £2,481. 4*s.* 10*d.* A dividend of £1,536 (£3 per share) was declared, and £945. 4*s.* 10*d.* carried to credit of next account.

At the Copper Hill Mine (Jan. 28), the accounts for the four months ending December showed—Ores sold (deducting £209. 12*s.* dues, at 1-16th), £3,144. 0*s.* 5*d.*; ᵔndries, £29. 4*s.* 4*d.*=£3,173. 4*s.* 9*d.*—Balance last audit, £403. 17*s.* 2*d.*; mine ᵗ, merchants' bills and sundries, £2,013. 1*s.* 8*d.*: leaving credit balance,

£756. 5*s*. 11*d*. The profit on the four months' working was £1,160. 3*s*. 1*d*. A dividend of £512 (£2 per share) was declared, and £244. 5*s*. 11*d*. carried to credit of next account. Captains J. Davey and Son, Inch and Johns, reported upon the various points of operation.

At the SOUTH TOLGUS MINE (Jan. 28), the accounts for November and December showed—Balance from last audit, £68. 1*s*. 9*d*.; ore sold, £2,753, 10*s*. 9*d*.= £2,821. 12*s*. 6*d*.—Mine cost, merchants' bills and sundries, £2,267. 1*s*. 3*d*.: leaving credit balance, £554. 11*s*. 3*d*. The profit on the two months' working was £486. 9*s*. 6*d*. A dividend of £512 (£1 per share) was declared, and £42. 11*s*. 3*d*. carried to the credit of the next account.

At the MINERA MINING COMPANY meeting (Jan. 28), the directors declared a dividend of £3. 10*s*. per share, from the profits to last Christmas.

At the PEN-AN-DREA UNITED MINES (Jan 29—Mr. Robert Pulsford in the chair), the accounts showed—Credit balance last account, £1,546. 17*s*. 9*d*.; tin sold since last meeting, £2,955. 19*s*. 9*d*.; copper ore, £279. 3*s*. 9*d*.; arsenic, £55. 10*s*.; calls received, £1,721. 12*s*. 10*d*.=£6,559. 4*s*. 1*d*.—September, October and November labour cost, £3,178. 3*s*. 2*d*.; merchants' bills, &c., £2,199. 11*s*. 8*d*.; leaving balance in hand, £1,181. 9*s*. 3*d*.

At the CARN BREA MINING COMPANY (Jan. 31), the directors declared their 112th dividend of £2 per share—making the sum of £271. 10*s*. already paid on each £15 share.

At DOLCOATH MINE meeting (Feb. 3), the accounts for November and December showed—Balance last audit, £528. 4*s*.; by copper ores sold, £282. 4*s*.; tin ore, £11,011. 6*s*.; extra carriage of tin, £10. 10*s*. 7*d*. (less dues, £470. 11*s*. 3*d*.; and rates, £50.)=£11,311. 13*s*. 4*d*.—By tutwork and surface labour, £4,349. 14*s*. 10*d*.; tribute, £970. 0*s*. 9*d*.; merchants' bills, £2,082. 18*s*. 10*d*.; making profit on the two months' working, £3,380. 14*s*. 4*d*. A dividend of £3,222 (£9 per share) was declared, and £686. 18*s*. 11*d*. carried to next account. The agent's report is among the Mining Correspondence.

At WHEAL BASSET (Feb. 4), the accounts for November and December showed—Balance last audit, £1,549. 2*s*. 8*d*.; ore sold and sundries, £4,880. 17*s*. 5*d*.= £6,430. 0*s*. 1*d*.—Mine cost, merchants' bills and sundries, £3,156. 9*s*. 3*d*.; leaving credit balance, £3,273. 10*s*. 10*d*. The profit on the two months' working was £1,724. 8*s*. 2*d*. A dividend of £1,536 (£3 per share) was declared, and £1,737. 10*s*. 10*d*. carried to the credit of next account.

At the WEST CARADON MINE (Feb. 5—Mr. Harris in the chair), the accounts for September and October showed a profit of £879. The balance of assets over liabilities was £5,374. A dividend of £1,024. (£1 per share) was declared, and a balance of £4,350 carried to the credit of the next account. Details in another column.

At DRAKE WALLS (Feb. 6), the accounts for the three months ending December showed—Balance last audit, £1,248. 4*s*. 2*d*.; tin ore sold, October, November and December, £4,289. 7*s*. 10*d*.; arsenic sold, £137. 10*s*. 10*d*.; account overcharged by Duchy of Cornwall, £1. 1*s*.=£5,676. 3*s*. 10*d*.—Mine cost, dues, &c., October, November and December, £3,874. 10*s*. 8*d*.; extra disbursements, £70. 3*s*. 11*d*.= £3,944. 14*s*. 7*d*.: leaving credit balance, £1,731. 9*s*. 3*d*.

At ST. IVES WHEAL ALLEN meeting (Feb. 5), the accounts showed a balance of only £389. 15*s*. against the mine at the end of December, 1861, and a call of 7*s*. 6*d*. per share was made. The 30, east of Giesler's shaft, is worth £18 to £20 per fathom, and they have had a good lode in this end for the last 12 fathoms; this level is also driven further east than any other below the adit, which looks well. The 10, east of Roderick's shaft, is worth £20 per fathom, and the shaft is about to be sunk to the 20, and a good lode is expected in sinking, The stopes and pitches have improved. They have sold 6 tons 7 cwts. 2 qrs. 20 lbs. of black tin, and in future regular sales will be made, while the costs will be much lighter than hitherto, all the surface work, &c., being complete. The agents state, "The mine is gradually improving, and we believe it will continue to do so."

At HERODSFOOT Mine (Feb. 4), the accounts showed a profit upon the four months' working to end of December of £2,167. 19*s*. 8*d*.; a cash balance of £1,443. 16*s*. 11*d*.; and a balance of assets over liabilities, of £3,145. 6*s*. 10*d*. A dividend of 35*s*. per share was declared. Messrs. Loam, Glubb, Caunter, Davy, Hawker and Medland were re-elected members of the committee. Captain T. Trevillion reported on the mine, which was in good working trim, never better at any former time. The qualities of the ores also we e never richer then during the last four months, as the

average price of the two 85-tons parcels realised £27. 16s. per ton; this is very satisfactory, especially when the reserves of orey ground in the mine are not in the least diminishing, but rather on the increase, and they look forward with confidence for regular and continued dividends.

At the TINCROFT MINING COMPANY (Feb. 7), the directors declared a dividend of 5s. per share.

At CHARLOTTE UNITED MINES (Feb. 6—Mr. Alexander in the chair), the accounts for the four months ending November showed—Balance last audit, £2,590. 12s. 2d.; August mine cost, merchants' bills, &c., £1,014. 9s. 4d.; September, £1,144. 5s. 8d.; October, £1,025. 18s. 8d.; November, £1,082. 1s. 9d.; Mr. Pike's lease, £26. 5s.=£6,883. 12s. 7d.—Call, £2,894. 13s. 9d.; copper ore sold £2,322. 0s. 3d.; tin, £25. 3s. 9d., leaving debit balance, £1,641. 14s. 10d. The report of the agents, Captains R. Kendall and J. Penberthy, recommend an application to the lords to remit dues until the mines become more remunerative. A call of 5s. 6d. per share was made. It was resolved that a petition in the Stannaries Court be filed forthwith against all shareholders in arrear of call; that the operations recommended by the agents be carried out with vigour; and that an application be made to the lords for a suspension of the dues. The committee of management were re-elected.

At KELLY BRAY (Feb. 13—Mr. J. Field in the chair), the statement of accounts for the three months ending December showed—Balance last audit, £107. 4s. 1d.; call received, £486. 0s. 6d.; copper ore sold, £753. 3s. 5d.=£1,346. 8s.—October, mine cost, merchants' bills, &c., £429. 17s. 1d.; November, ditto, £419. 4s. 2d.; December, ditto, £425. 15s. 5d.; expenses and loss upon forged shares, £24. 3s. 1d.=£1,298. 19s. 9d.; leaving credit balance, £47. 8s. 3d.

At WHEAL TRELAWNY (Feb. 8—Mr. W. Page in the chair), the following statement of accounts for the three months ending November, showing a profit of £1,265. 6s. 6d. (or 24s. per share), was submitted:—Silver lead ore sold, £6,271. 3s. 3d.; mine cost, £4,243. 7s. 8d.; merchants' bills, £1,288. 16s. 10d.; Royalty, £306. 0s. 9d.; interest, £39. 0s. 2d.; income tax, £128. 8s. 10d.; incidental expenses, 2s. 6d.=£5,005. 16s. 9d.; leaving credit balance, £1,265. 6s. 9d. The assets exceeded the liabilities by £2,106. 18s. 2d. A dividend of 15s. per share was declared, leaving a balance of £485 to be added to the reserve fund.

At the CLIFFORD AMALGAMATED MINES (Feb. 19), the accounts for November and December showed—Ores sold, £14,273; balance last audit, £1,135; merchants' bills, £2,592; Redruth and Chacewater Railway, £278: on account of coals, £1,550; labour cost, £6,474; leaving credit balance, £2,240. A dividend of £1,862 (12s. 6d. per share) was declared, leaving credit balance, £378.

At PROSPER UNITED (held at the company's offices, Bishopsgate-street Within, Feb. 21, Mr. F. Hill in the chair), the accounts showed—Balance last audit, £7,885. 0s. 5d.; mine cost, Sept. to Dec., and subsist for Nov. to Feb. inclusive, £2,897. 7s. 3d.; merchants' bills four months ending Dec., £3,130. 7s. 11d.;= £13,912. 15s. 7d.; calls received, £5,906. 15s.; arrears received, £110; copper ore sold, £596. 4s. 2d.; tin sold, £415. 12s. 7d.=£7,028. 11s. 9d.; leaving debit balance, £6,884. 3s. 10d. A call of 23s. per share was made.

WALES.

At the Vigra and Clogau meeting, January 24, the sum of £100 was awarded to the directors for their services to the end of last year, and it was resolved that £5. 5s. should be allowed as attendance fees for each future board meeting; the sum of £50 was voted to Mr. Gillman for past services, and his future salary as secretary was fixed at £100 per annum; Mr. Goodman was awarded £20 for past services and advice, and his fee as auditor for the present year was fixed at £10. 10s. The shafts suggested by Captain Paull in 1860, and subsequently by Captain Pascoe, for facilitating the profitable working of the copper lodes, have, from serious impediments, been abandoned, and two deep adits, under the advice and to meet the views of the Government surveyor, have been opened, one at Vigra and the other at Clogau Mountain, and negotiations are pending for effecting these cuttings by machinery. During the past year only 25 or 30 tons of copper ore had been dressed, and, as it does not pay to raise the ore by the present mode, the prosecution of the same has been suspended. The gold is obtained from the St. David's lode, worked under a license from the Crown, distinct from Vigra and Clogau. Capt. John Parry reports that during the year 37½ fathoms of ground have been removed. The quantity of auriferous ore carted down from St. David's lode and

passed through the large machines was 449 tons 18 cwts., yielding 580 ozs. 10 dwts. 7 grs. of fine gold, and the visible gold that passed through the small machines was 6 tons 2 cwts. 32 lbs. yielding 2,303 ozs. 11 dwts. Capt. Pascoe thinks there is plenty of auriferous quartz above the level for the present machines for many years.

COLONIAL AND FOREIGN.

At the Scottish Australian Mining Company meeting (Mr. W. H. Dickson in the chair), it was stated that the company was established with the immediate object of purchasing eleven specific properties in New South Wales—one of which was known to contain copper and others coal—and of acquiring any other mineral properties, having great promise, that those entrusted with its management might from time to time have it in their power to secure in the Australasian colonies; and, having obtained them, either to work them, or, after more or less exploration, to dispose of them as may appear most beneficial to the company. That it was also confidently anticipated that the company, having a fruitful and constantly widening field to work in, would by degrees and in due time become a mining association of an extensive and important character, not only general in its objects but very successful in its results. That the procedure by which the directors desired to make a commencement to carry out the objects of the company was confined to the development of the copper mine in the Good Hope property, and to the stablishment of a colliery near the port of Newcastle, perhaps the most rising town in the Australian colonies. The Chairman stated that the operations at Good Hope Mine during the past twelve months had been mainly directed to the sinking of the shaft below the 30-fathom level, and exploring to intersect the lode at that depth. The whole of the work had been economically conducted, and although a large amount of work had been done, the cost did not exceed £3,457. The most satisfactory results were anticipated from this property. With regard to the Cadiangullong Mine, which comprised an area of 564 acres, it was situated 14 miles from Orange, 40 from Bathurst, and 160 from Sydney. The terms upon which a 21 years' lease has been obtained were simply a royalty of 1-12th of the ore to be raised. A commencement of mining operations on the property was made at the end of July last, and though no machinery nor expensive appliances had been used, 600 tons of ore were brought to grass by the middle of November. Copper ore was found at 18 feet from the surface, where a lode was found 68 to 70 feet wide, and extending for at least half a mile in length. From all the data that could be collected relative to this property, there were abundant reasons for believing it would prove of great value, and become a permanently paying property. Of the 600 tons brought to grass in the short period above referred to, one-fourth yielded an average of 40 per cent. of copper, and the whole was estimated to average upwards of 20 per cent. The 600 tons was computed to be worth £12,000, while the cost of obtaining it did not exceed more than £2,000. The smelting works were probably completed by the present time. The company also had several coal properties, and the lease had been executed of 2,560 acres of coal producing land, situated near Newcastle. It had been fully proved to contain several seams of coal of the very best description. The lease of the Good Hope property was freehold. The Cadiangullong Mine was held upon a lease of 21 years, on a royalty of 1-12th; and the 2,560 acres of coal property was held upon a lease for 50 years. A Proprietor enquired if there was any truth in the rumour that five men in two days raised £400 worth of ore from the Cadiangullong Mine? The Chairman replied there had been a rumour to that effect, and he believed the rumour to be true. A Shareholder enquired as to the cost of carriage of ore or copper from Cadiangullong to Sydney? It was explained that it would not be comparatively heavy, as the roads in New South Wales (unlike the other Australian colonies) are excellent, having been made long ago by the labour of convicts. The road from Sydney to Bathurst was said to be as good as could well be desired. The report and accounts were then received and adopted, and the retiring directors and auditor reappointed. A special resolution was then unanimously passed, to the effect—That the capital of the company be, and hereby is, increased by the creation of 40,000 additional shareholders of £1 each, to be offered rateably, in the first instance, at par to all existing shareholders; and that the sum of 10*s.* per share shall be payable on all such additional shares on or before March 31st next; the holders of the additional shares

shall be entitled to participate in the profits and advantages of the company on precisely the same footing as the holders of the said 80,000 shares; in issuing the additional shares no fractional part of a share shall be allotted to any person, but all such fractional parts shall be offered for sale for the benefit of the company. A vote of thanks to the Chairman and directors terminated the proceedings.

Metal Markets.

The character of the market during the month has been marked by extreme dulness. Very little business has been doing, even at reduced rates, and many second-hand parcels hang on hand notwithstanding the low rates at which they are offered. Shipments to America and the Continent are on the increase; and for the former there are many orders on hand, which, under present circumstances, shippers are unwilling to execute without cash.

Iron.—The market for railway bars has remained without alteration during the month, and no improvement can be expected until the rate of production, now so far in excess of the demand, is reduced. Merchant bars have been in good demand, but no advance has been possible, nor likely to be, as long as railway orders remain so scarce: price, £5. 2*s.* 6*d.* to £5. 5*s.* at the works; and £6, f. o. b. in London. For Staffordshire makes there has on the whole been rather more enquiry, and they seem to be recovering from their long-continued dulness; but there has been no alteration in prices. Swedish bars have been quiet, in fair request at quoted prices. Scotch pigs have slightly fluctuated during the month, having in the early part advanced about 1*s.*, being quoted 49*s.* 3*d.* to 49*s.* 9*d.* mixed numbers; later on they declined from 49*s.* to 48*s.* 9*d.*

Copper.—On the 3rd of the month, the smelters of English announced a decline in fixed rates of £5 per ton on raw, and ½*d.* per lb. on manufactured descriptions; making the official rates £102. 10*s.* for cake, tile and ingot, and 11½*d.* for sheet and sheathing. This reduction had been anticipated, for the fixed rates had been for some time nearly nominal. Indeed, in some quarters a greater drop was expected; for the selling prices are still much below the fixed rates, numerous orders, particularly for India, having been executed at 10¾*d.*, or ¾*d.* under price. The continued fall in the standard necessarily depresses the market, and cake and tile can be purchased very much under fixed rates. Foreign has been dull, Burra Burra having changed hands at prices ranging from £98 to £97; Kapunda, £100 to £98; Chili, £90 to £88, and Spanish £88 to £90. Yellow metal was lowered, with copper, to 9½*d.* but is selling at 1*d.* under that rate.

Tin.—The demand for English has been quiet but steady, smelters adhering pretty closely to fixed rates. Foreign has been very dull, but has recently slightly rallied. Straits have ranged from £119 to £116; Banca, £124. 10*s.* to £123. During the month Tin plates have been in good demand, principally for shipment to America, to anticipate the expected increase in duty.

Lead.—This metal has, on the whole, been firmer during the month. In the early part there was a slight tendency to an advance, but later it has been rather the other way. Still sellers are tolerably firm.

Spelter.—The Spelter market has been quiet, and in the early part of the month sales were made at £18 to £18. 2*s.* 6*d.* This quotation, however, has scarcely been maintained, sales having been made as low as £17. 10*s.* Zinc steady through the month at £23. The following is from the last report of Messrs. Berger Brothers :—"Since our last nearly 800 to 900 tons

have been bought at £18 to £18. 2*s*. 6*d*. for parcels on the spot. Orders from India are still scarce, but as the shipments to that quarter have been so much below the average during the last twelve months, we look forward shortly for a brisk demand from there, and whilst prices on the Continent are above ours, we cannot expect a very great supply: hence our stock is likely to be steadily reduced, and prices firmly maintained, with prospects of improvement.

Stocks on Feb. 1,	1862	Tons 5,423	price from	£18	0	0	to	£18	2	6
„ „	1861	 4,701	„	18	7	6	to	18	10	0
„ „	1860	 3,742	„	21	0	0	to	21	5	0
„ „	1859	 4,441	„	22	10	0	to	22	15	0
„ „	1858	 2,204	„	27	0	0	to	27	5	0

Metallic-Ore Markets.

Tin.—The standards for black tin remain unaltered at,

Refined ... £111.
Common ... 107.

In a recent number, the *West Briton* states that "The demand for metal appears to be quite equal to the supply of Tin from the mines, but there appears no upward tendency."

Copper.—At the four Cornish sales we give this month, the average produce, price per ton, and standard, have been as follows:—

	Produce.	Price per Ton.	Standard.
Jan. 30	6⅛	£5 4 6	£129 1 0
Feb. 6	5⅞	4 16 6	125 9 0
„ 13	6⅜	5 4 0	123 13 0
„ 20	5⅜	4 5 0	128 19 0

Thus, through the whole month, there has been a dropping standard. What the exact decline really has been is thus estimated by the *Mining Journal* and *West Briton*. At the sale of January 30th, the former makes the decline 20*s*., and the latter 18*s*.; at that of Feb. 6, the *Journal* gives a decline of £2, and the *West Briton* one of £2. 2*s*.; at that of Feb. 13, the former makes the fall £2, and the latter only £1. 14*s*.; and at that of Feb. 20, the *Journal* estimates the decline at £2, while the *West Briton* only makes it £1. 2*s*. It will be remarked that the estimates of these two papers are much nearer than was the case in former months, which might lead one to believe, were it not for the experience of a long series of discrepancies, that really calculations on this subject are not so uncertain as we have stated them to be.

Lead.—Comparing the sales of Lead Ore for the month with those of the former month, there appears to be no material alteration in prices.

London Share-Market.

The amount of business transacted during the month may be characterised as fair, considering the almost inanimate condition of the metal market. The easy terms upon which money is negotiable has however given a degree of stability to the share markets, and the continued eagerness evinced by the public to invest in certain selected mines augurs favourably for the ensuing month.

The most important and recent discovery is that at Wheal Grenville, where the lode in the 80-fm. level is reported to be worth £50 per fm. for tin, whilst the copper lode in the 100-fm. level west is also showing indications of improvement, being worth at the moment £12 per fm. This mine has been working for a considerable period in comparative poverty; it will therefore be a source of great encouragement to the shareholders to find that at length it shows some signs of eventually rewarding their perseverance and patience. There have been many improvements expected during the last few months, and it is therefore confidently hoped that the above is only the precursor of many others so anxiously awaited.

The details of the operations in shares will be gathered from the following:—

Alfred Consols occasionally enquired for, but not many actual transactions; the nominal quotations are given as $\frac{1}{4}$-$\frac{1}{2}$, and the latest reports received from the mine are of a more cheering character than for some time past.

Condurrows have been frequently dealt in, and were quoted as high as 77$\frac{1}{2}$–80, but are at present rather easier.

Carn Brea attract a little attention, and close 70–72$\frac{1}{2}$.

Cook's Kitchen shares have been gradually absorbed for investment for some weeks past; they are now very scarce even at advanced prices, and the mine is reported to be looking most favourable.

Clifford Amalgamated have been very fair at 30-32. At the meeting a dividend of 12*s.* 6*d.* per share was declared, and a credit balance of £378 carried forward.

Camborne Vean more in request at 2$\frac{1}{8}$-$\frac{3}{8}$.

Carn Camborne has remained very steady at 11 to 13, with a fair enquiry.

Craddock Moor very scarce, only one or two shares having changed hands: the price is firm at 27-9. Devon Great Consols have been much sought after, but holders do not seem inclined to part with their shares, as the many orders to buy have been returned unexecuted: they close 410-20. East Basset continues dull in character, at lower prices—47$\frac{1}{2}$-50. East Caradon, after touching 31, receded again to 30$\frac{1}{2}$-$\frac{3}{4}$, at which they close. A large amount of business has been done in these shares at various prices between 30 and 31: the latest reports from the agents give the valuations of the ends as follows:—The 50 east, £80 per fm.; 60 east, £50; Fawcett's lode, £15; new lode, £8; 60 west worth £40 per fm.

East Carn Brea remain tolerably steady at 10$\frac{5}{8}$-$\frac{7}{8}$: the mine is looking promising for further improvement, and the next sampling is expected to be 350 tons. East Grenville, after declining to 25*s.* sellers, improved to 30*s.*-32*s.* 6*d.* East Russell firmer at 3$\frac{1}{4}$. East Devon Consols steady at 1$\frac{3}{4}$-2. Great Fortune have been largely dealt in, and close very firm at 15$\frac{1}{2}$-16. Great Wheal Vor many buyers but no sellers at present prices, 6$\frac{1}{2}$-7. Great South Tolgus have been in demand and close lower.

In Herodsfoot only a moderate amount of business transacted, the price advanced to 38-40, but they close rather lower—35$\frac{1}{2}$-36$\frac{1}{2}$ ex div. The dividend declared at the meeting was 35*s.* per share, and the agent gave a very favourable report on the prospects of the

mine, stating that it was never looking better than at present. Hingston Down shares have been very flat for some time past, with scarcely any business doing: at the meeting the accounts showed a credit balance of £145. 2*s.* 4*d.* Marke Valley remained very firm and steady at $10\frac{1}{8}$-$\frac{3}{8}$; the mine continues to look well, and the samplings are kept up without intrenching on the reserves. New Seton in considerable request, and advanced to 65-70; they close a trifle weaker. North Downs declined to 5-$\frac{1}{4}$; there have been numerous dealings in these shares throughout the month, but there has been a preponderance of sellers. North Roberts advanced to 25*s.* "buyers," but subsequently declined to 20*s.*-22*s.*, at which they close. North Basset rather more enquired for at 3-$\frac{1}{2}$. North Treskerby have fluctuated a good deal, and close weak, 21-22. North Crofty 2-$2\frac{1}{4}$ and enquired for. Noth Roskear 22-23, with a good busines doing.

Par Consols, after being dealt in at 9, close 8-$8\frac{1}{2}$, owing to sellers pressing the shares on the market. In Providence shares, there has been a moderate amount of business done during the month; the price has become lower towards the close, being 41-43. Prosper United nominally $2\frac{3}{4}$-$3\frac{1}{4}$, a call of £1. 3*s.* was made at the meeting. Rosewall Hill and Ransom close $4\frac{5}{8}$-$\frac{7}{8}$, and have been largely dealt in; the 115 West is expected to improve in a short time. South Tolgus occasionally sought after. South Caradon are quiet but firm at $317\frac{1}{2}$ to $22\frac{1}{2}$, with only a limited number of transactions. South Frances weak in character, caused principally by the protracted boundary dispute with the West Basset adventurers: the quotations at present are $97\frac{1}{2}$-$102\frac{1}{2}$. St. Ives Consols still drooping; they close 24-26. Stray Park very steady at 30-31.

Tincroft greatly in request, and shares very scarce: the price has advanced to $9\frac{1}{4}$-$\frac{3}{4}$. Treloweth remain steady at 25*s.* to 30*s.* without much enquiry. Tamar silver lead, very dull at present; nominally quoted $1\frac{1}{2}$-$\frac{3}{4}$. Wendron Consols have been in great request, and advanced to 13-14. West Caradon weak at 39-41. West Frances a little enquired for at 9-11. West Rose Down are eagerly picked up by investors. The prospects of this mine are very encouraging, as the sett adjoins Marke Valley; the shares are now 15-16. West Polmear have declined to 2s. 6*d.* to 4*s.*; the next lode will, it is expected, be intersected in about the space of another week. West Seton shares a shade firmer, the mine looking better. Wheal Arthur 14*s.* 6*d.*, 15*s.* 6*d.*: the lode in the 50 fm. level is worth two tons of copper ore per fm. Wheal Grylls have advanced to 15-$\frac{1}{2}$; the supply of these shares has been very scanty for some time past. Wheal Bassets, $97\frac{1}{2}$-100 with a little enquiry; Wheal Buller firmer at 70-75.

Wheal Grenville after declining to 30*s.*, sellers, have recovered, and advanced to $2\frac{3}{8}$-$\frac{5}{8}$, owing to the important improvement already mentioned. Wheal Uny steady at $5\frac{1}{8}$-$\frac{3}{8}$. Wheal Kitty, Lelant, in considerable request, and advanced to $11\frac{1}{4}$-$\frac{3}{4}$; the prospects of this mine are rapidly improving. In Wheal Ludcott a very large number of shares have changed hands at advanced prices; they close $2\frac{7}{8}$-3. Wheal Margaret rather weaker, at the close 41-43. Wheal Mary Ann, $15\frac{1}{4}$-$\frac{3}{4}$, and very little doing. Wheal Seton's have been dealt in to a considerable amount; they close 121-3; a dividend of 30*s.* per share was declared at the meeting. Wheal Trelawny close weaker

than they have been, viz., 17-18; a dividend of 15*s.* per share was declared at the meeting, and a credit balance of £1,320 carried forward. West Basset, very steady, 13-14. Wheal Unity have been in request, and close 19*s*-21*s*.

In Welsh mines there has been a good business done, although the deplorable accident at Bryn Gwiog has cast a sad gloom over this district. At Billins, the lode in the level driving west is worth one ton per fm., and improving; the shares are 17-18. Lonkrake rather quiet; at the meeting a call of £1 per share was made. North Minera, 17-19, with some few enquiries; at the meeting of the Minera Company, a dividend of £3. 10*s.* per share was declared. Mount Pleasant lead mine divided £1 per share, at the meeting of the Company, held at Chester.

In foreign mines there has been an average amount of business done in the Stock Exchange. St. John del Reys have fluctuated between 63 and 67, and many transactions have taken place; they close 63-5. United Mexican remain tolerably steady at present at 8½-¾, but at one time during the month were marked as high as 9¼. Great Northern Copper have declined, and close 1-¼; a call of 5*s.* per share was announced. East del Rey steady at 1½-¾. Port Philip 1-¼, with frequent dealings. Scottish Australian have been in considerable request, and close at an advance 2⅛-⅜. North Rhine rather improved owing to better reports from the mine. Maraquita have been dealt in at ⅞. Dun Mountain, firm at 1-⅛. General Mines steady, 23-24, ex. dividend. Worthing, not much doing, ½ to ⅝. Bon Accord very dull at ¼-½. Fortuna, 2-2½. Jus Cobre Copper, Linares, Kapunda, Brazilian, Lusitanian and Pontgsiband very little business doing, and scarcely any variation in prices.

Friday, 28th February, 1862. 2.30 P.M.

The following are the closing prices :—

Not much doing besides settling the account. East Caradon remain steady; East Carn Brea very strong at an advance. A good business doing in Wheal Grenville and East Grenville. Sellers of Buller and Clifford. Wendrons rather weaker.

Camborne Vean, 1½ to 2; Carn Camborne, 13/. to 15/.; Cook's Kitchen, 30¾ to 1; Devon Great Consols, 410 to 20; East Basset, 47½ to 50; East Caradon, 30⅝ to ⅞; East Carn Brea, 11 to ¼; East Grenville, 32/6 to 35/.; Great Wheal Fortune, 15½ to 16; Great Wheal Vor, 6½ to 7; Herodsfoot, 35 to 36; Marke Valley, 10½ to ¼; North Downs, 5 to ¼; North Robert, 18 to 20; North Treskerby, 20 to 21; Providence Mines, 41 to 42; South Caradon, 317½ to 22½; Stray Park, 30 to 31; Tincroft, 9⅝ to ⅝; Wendron Consols, 13 to ½; West Caradon, 40 to 1; West Rose Down, 15½ to 16; West Seton, 275 to 80; Wheal Buller, 65 to 70; Wheal Clifford, 30½ to 1½; Wheal Grenville, 2⅞ to 3½; Wheal Ludcott, 2⅞ to 3½; Wheal Margaret, 43 to 4; Wheal Mary Ann, 15½ to 16; Wheal Seton, 121 to 3; Wheal Uny, 5½ to ⅝.

Provincial Share Markets.

DUBLIN.—The following report is condensed from the *Mining Journal*;—Towards the end of January the market was rather active, and prices experienced frequent fluctuations, exclusively regulated by supply and demand. Wicklow Copper Mining Company shares rose from £54. 7*s*. 6*d*. to £55, and again receded to £54. 5*s*. Mining Company of Ireland shares were more steady, and in request at £16. 5*s*., ex. div. General Mining Company for Ireland shares offered at £5. 7*s*. 6*d*., and takers at £5. 5*s*. Connorree shares on sale, and weak at 31*s*. 6*d*. Carysfort shares at 7*s*. 6*d*., or a reduction of 6*d*. in the price last reported.

Early in February the shares of the Mining Company of Ireland steadily advanced from £16. 5*s*. to £16. 15*s*. for cash, and £16. 17*s*. 6*d*. for account, in great request. Wicklow Copper Shares sold at £54. 5*s*., but recovered to £54. 10*s*., in fair demand. General Mining Company for Ireland shares on sale at £5. 5*s*. Carysfort shares 7*s*. 6*d*. Connorree shares nominally quoted at 31*s*. to 32*s*. 6*d*. sellers. The preference shown for the shares of the Mining Company of Ireland over those of the Wicklow Copper Mining Company is in a great measure attributable to the more convenient subdivision of the capital of the former into 20,000 shares, while that of the latter is divided into 5,000 only—thus rendering them much heavier, and placing them at a great disadvantage in juxtaposition with those of the Mining Company of Ireland, which is strikingly demonstrated by the present prices. With about equal prospects and public favour, the Mining Company of Ireland shares now command in round figures £17 per 20,000th part, giving a market value to that stock of £340,000, while those of the Wicklow Copper Mining Company, at the present average price of, say, £55 per 5,000th part, give only £275,000 as the total value of their mines, and a difference in favour of the property of the Mining Company of Ireland of £65,000.

Later in the month the Mining Company of Ireland shares rapidly rose as high as £18, but suddenly dropped to £17½, again rallying, however, to £17. 10*s*. Wicklow Copper Mining Company weak, at £54, or a fall of 10*s*. General Mining for Ireland nominally £5. Carysfort shares taken at 7*s*. 6*d*., sellers at 8*s*. After the publication of the accounts of the Connorree Mining Company for the six months preceding November 30th last, the shares fell to 28*s*. and 29*s*., sellers, being a fall of 3*s*. 6*d*. to 4*s*. per share. The accounts alluded to show that out of the proceeds of 40,000 shares at 20*s*., or £40,000, there has been expended to November, 1860—for the mine, expenses of promotion and new work, £26,232. 5*s*. 6*d*.; and for "new work" to May 31, 1861, £3,748. 15*s*. 2*d*.; and to November 30, 1861, £2,778. 3*s*. 2*d*.; leaving a balance on November 30, 1861, of £7,290 16*s*. 2*d*. Of this has been further expended £3,361. 16*s*. 2*d*. for "mining" expenses to November 30, 1861, without explaining the difference between "new works" and "mining expenses;" and £836. 5*s*. 8*d*. for directors, auditors, and office expenses in Dublin and London for the 12 months ending November 30th last, &c.

Still later in the month business was active, but prices of shares in the two dividend-paying mines—the Mining Company of Ireland and the Wicklow Copper Company—not been well sustained; the former fluctuated from £17. 15*s*. to £17. 7*s*. 6*d*., at which they were in request. The demand for Wicklow Copper Mining Company shares was considerable, but sellers numerous enough to bring down the price to £53. 10*s*., being a reduction of 10*s*.; this has been caused chiefly by a feeling of uncertainty as to the resolution the shareholders may come to at the extraordinary general meeting called for Tuesday next, and as to the view leading capitalists may take of the extent of the benefit to be conferred on the Wicklow Copper Mining Company by the proposed amalgamation with the ancient Hibernian Mine Company. The latter was founded in 1780, and soon after incorpo-

rated by Act of Parliament for the purpose of working Ballymurtagh Mine, Ovoca, Co. Wicklow, and for other objects. These mines in the course of many vicissitudes to which valuable mining properties are often subjected before they acquire permanent success, passed through the hands of Mr. Henry Hodgson to the present Wicklow Copper Mining Company, the principal and oldest shareholders of which are also shareholders in the Hibernian Mine Company, and, therefore, lessors to themselves. This same old company has also certain vested rights in the Arklow Harbour, and in a once contemplated canal on the course of the River Ovoca. Any arrangement which will effect, on fair and equitable terms, a complete amalgamation of these two companies, must save much profitless trouble and attendant expenses, and at any rate for that reason, if for no other, be beneficial to so extensive and important a concern as the Wicklow Copper Mining Company,

Carysfort shares have been largely taken at 9*s*. 6*d*., at which they are still procurable, and the owners of Connorree shares hold on for 30*s*. General Mining Company for Ireland shares a shade better, some having been bought at £5. 2*s*. 6*d*., at which price they offered.

MINING REVIEWS.

The Eleventh Annual Statistics of the Mining Interest. By William Henry Cuell, Esq. London: published at the Mining Journal Office; and by Messrs. Watson & Cuell, St. Michael's Alley, Cornhill. Price Sixpence.

Last month we noticed Mr. J. Y. Watson's Review of the Progress of Mining during the last year. To Mr. Watson's Review Mr. Cuell's tabular Statistics form a valuable companion. They comprise the Dividend Mines of Cornwall, with the Welsh Mines in Messrs. Taylor's Office, and one or two others known in the "market."

Among the Cornish Dividend Mines, Mr. Cuell enumerates 46, which have divided an aggregate amount of £260,906. At the head of these stands Devon Consols, which divided £43,000; followed by Phœnix, giving £21,000; West Seton, £20,800; Dolcoath, £16,826; South Caradon, £15,360; and Wheal Clifford, £14,500. Among the Welsh Mines, Minera heads the list, having divided £27,450.

Besides the number of shares and dividends, Mr. Cuell's tables give the following particulars:—the metals produced by each mine, the parish in which it is situated, the name of purser, or secretary, and the address of the office, the system on which the partnership is conducted, the intervals of the meetings, the total metallic produce in tons of ore and money value, and the dates of the leases and the dues. That such a mass of information, compressed into the small compass of a single table, is most valuable to any one interested in mining affairs, is evident. The collection of it must have involved a great amount of labour; and the arrangement shows that Mr. Cuell is eminently a statistician.

EXTRACTS FROM MINING CIRCULARS.

From Mr. Edward Cooke, 5, *Hercules Passage, London.*

The new year commenced with an active market for British Mines. Subsequently a slight reaction has taken place, owing no doubt to the decline in the standard for copper ore, and the comparative dulness in the metal market generally, consequent upon the unhappy state of political matters in America, whereby we lose one of our best customers for metals. While there have not been any very startling discoveries lately, improvements in several progressive mines have taken place, thereby causing a better demand for this class of property. If we may judge by the numerous concerns styled "Mining Companies" that have been brought out lately, it may be inferred that speculation is rife just now. I fear, however, that like many previous ephemeral schemes they have been brought out by dint of reports, &c., that are not borne out by facts; hence nothing

but disappointment and loss is likely to attend those who embark their capital in them. There are many well-managed and established progressive mines that offer sufficient scope for the operations of those disposed to speculate in this class of property. With a proper regard to the district in which a mine is situated, and the respectability of its management, *chances* of large profits on an outlay may be frequently witnessed. I may instance East Caradon, Wheal Grylls, East Carn Brea, Tincroft, Devon Great Consols, Cook's Kitchen, Herodsfoot, and many other mines that have risen in price to an enormous extent during the past few months. There are others that will in all probability have a similar rise in price during the present year.

By making a proper selection, investments in British Mines can be made highly lucrative. Success may not immediately follow, but if a good district be chosen to operate in, and patience be exercised, the chances are greatly in favour of success: witness the Gwennap and Redruth districts. A great deal of patience was observed by the parties who worked Wheal Clifford, Great Consols, Wheal Buller, Wheal Basset, Dolcoath, &c.; but they reaped their reward in due time, and realized large fortunes by the interest they held in these respective mines, and are now counted among the wealthiest families in Cornwall. There are yet mines in the Gwennap and Caradon districts to be developed, that I confidently look forward to produce similar results to those I have named. The latter is comparatively a young district, although at present possessing some of the richest mines in Cornwall, and several progressive mines that only require time for development to become equally productive. As the spring advances we may hope for more activity in commercial matters generally, and Mining will not be the last branch of our home industry that will feel the beneficial effects of a revival in trade.

From MESSRS. WATSON and CAELL, 1, *St, Michael's Alley, Cornhill.*

Several speculative mines are getting into favour, and a large business has been done in them at advanced prices. Among them are the mines we have so often called particular attention to, from points we know must come off, sooner or later, though long deferred. Grenvilles, it will be seen, have had a great rise, but not yet to half their value, considering the discovery and the splendid situation of the mine. East Grenvilles, also, must take a good turn soon, as they will commence sinking the shaft below the 45 on the same lode, worth £60 per fathom at the 80 level in Grenville. Unitys have advanced to 20/. and will go to £2 if the lode is cut as good at the 75 as it is at the 50. South Caradon Wheal Hoopers in good demand. Bottle Hills in demand. Redmoors, after being depressed, are improving, Devon Consols, 410 415—business done. East Caradons firm. Marke Valleys in demand—a large business done. Hingston Downs improving. East Setons in request, at ⅝ 10/.

From MR. P. WATSON'S *Mining Circular, No.* 205.

The Mining Share Markets have during the past three or four weeks shown a gradual decrease in transactions, both for dividend and progressive shares; the depreciation or variation in prices, however, is scarcely perceptible, and the market on the whole may be characterised as almost at a standstill, yet somewhat firm, owing, no doubt, to the public, as investors, being reluctant to operate at present, seeing week after week the very serious fall in the standard for copper ores at the Cornwall and Swansea ticketings, which is now at a lower figure than for the last eight or nine years. The reduced price of tin also has had a depressing influence.

A reference to the Board of Trade Returns published last week, for the last twelve months, will show the very serious diminished exports of copper, tin and lead; this is owing mostly to the Secession movement in America; followed by actual hostilities on a gigantic scale,—and not forgetting, likewise, the obnoxious American tariff, which has had a very prejudicial

effect in this country. It is now generally believed, however, that in the price of copper and tin more especially, we have seen the worst, and we may therefore look forward to a favourable reaction, which will be exceedingly cheering to investors in mines,—for on the *up and down* movement of the metal market, from many years' experience, we find that the mining share markets are generally very sensitive to follow in the wake.

Considerable support has been given of late to prices of nearly every class of investments, through the accumulation and cheapness of money, excepting Cornish and Devon mining, and it would appear that the public have not yet paid that attention to this class of legitimate and profitable investment which it certainly deserves. Without going into detail to show the *millions sterling* given in profits to shareholders, we will content ourselves by naming the fact to the investing public, that there are at the present time many mines now paying 15 to 20 per cent. per annum on the present market price of shares, with every probability of an increase, whilst those of a progressive character are yielding considerable returns of ores,—many of which are on the eve of a dividend state, and a considerable advance in market value is fully anticipated.

BOARD OF TRADE RETURNS.

The returns for the month and twelve months ending December 31st, 1861, were issued by the Board of Trade on Saturday last. We give a statement of the total declared value of exports of British and Irish produce and manufactures during the month and twelve months in the last three years.

	For the Month.	For Twelve Months.
1859	£10,827,242	£130,411,529
1860	12,128,541	135,891,227
1861	9,760,129	125,115,133

For the month the exports were less by £2,368,412, or 19 per cent. than in the same month of last year, and less by £1,067,113, or about 10 per cent., than in December, 1859. The figures for the twelve months show a decrease of £10,776,094, or about 8 per cent., compared with 1860, and a decrease of £5,296,394, or about 4 per cent. as compared with 1859,

In examining the exports of copper, tin, lead, and iron in the different forms, we arrive at the subjoined general figures for the month:—

	Month of December.		
	1859.	1860.	1861.
Copper—unwrought	£35,977	£72,947	£28,858
sheets and nails	178,498	143,467	129,339
Tin—unwrought	44,478	29,223	19,777
tin plates	64,543	98,499	89,767
Lead	31,608	52,071	25,189
Iron—in pig, bar, bolt, rod, railway, &c,	330,835	428,371	311,252
Ditto — steel—unwrought	67,225	102,528	71,309

From the above figures a mere glance will show that as compared with 1860, the ratio of decrease in the month was much larger than the ratio of decrease on the whole year.

The exports of all articles to the United States for the last quarter of 1861, and for the whole year, gives as follows:—

	1859.	1860.	1861.
Quarter ending December 31st.	£5,046,183	£5,253,486	£2,167,218
For the whole year.	£22,116,372	£21,072,659	£8,639,971

The absolute net decrease in this branch of our American trade, as compared with 1860, was therefore £12,432,688; and we will here only remark that this sum pretty nearly corresponds with the amount of the deficiency in the year's exports to all parts, thus proving the dulness experienced in our export trade during the last year was almost wholly occasioned by the unfortunate affairs and condition of America.

Prices Current of Metals.

			Per Ton.		
IRON	Bars	in Wales	£5 2 6	@	£5 5 0
	,,	,, Liverpool	......		5 15 0
	,,	,, London	6 0 0	,,	6 5 0
	Nail Rods	,, Wales	5 12 6	,,	5 15 0
	,,	,, Liverpool	6 10 0	,,	7 5 0
	,,	,, London	7 5 0	,,	7 15 0
	Hoops (Staffordshire)	,, Liverpool	7 15 0	,,	8 10 0
	,, ,,	,, London	8 5 0	,,	8 15 0
	Sheets ,,	,, Liverpool	8 10 0	,,	9 5 0
	,, ,,	,, London	9 0 0	,,	9 15 0
	Bars ,,	,, Liverpool	7 0 0	,,	8 0 0
	,, ,,	,, London	7 10 0	,,	8 10 0
	Scotch Pig (No.1.g.m.b.)	the Clyde	2 8 6	,,	2 9 0
	Rails	in Wales.	5 0 0	,,	5 5 0
	Russian	C.C.N.D	......	,,	......
	Swedish—Hammered—large sizes		11 10 0	,,	11 15 0
	,, ,, Indian sizes		11 10 0	,,	11 15 0
STEEL	Hammered—faggot		......		16 10 0
	,, in kegs $\frac{1}{2}$ and $\frac{5}{8}$ in.		......		15 10 0
COPPER	Australian and other *fine* Foreign		96 0 0	,,	97 0 0
	Foreign Slab, for Prod. 96 per Cent.		......	,,	88 0 0
	English Tile and Tough		95 0 0	,,	102 10 0
	,, Best selected		98 0 0	,,	105 10 0
			Per lb.		
	,, Sheets, Sheathing and Rod		10½*d.*	,,	11½*d.*
	,, Flat Bottoms		11*d.*	,,	12*d.*
YELLOW METAL	Sheets, Sheathing and Rod		8½*d.*	,,	9½*d.*
			Per Cwt.		
TIN English	Common Blocks and Ingots		......		120*s.*
	,, Bars (in barrels)		......		121*s.*
	Refined		......		122*s.*
Foreign	Straits		117*s.*	,,	118*s.*
	Banca		......		125*s.*
			Per Box.		
TIN PLATES at Liverpool 6d. Less.	Charcoal IC		28*s.*	,,	29*s.*
	,, IX		34*s.*	,,	35*s.*
	Coke IC		22*s.* 6*d.*	,,	23*s.*
	,, IX		28*s.* 6*d.*	,,	29*s.*
			Per Ton.		
LEAD	Sheet		21 0 0	,,	21 5 0
	Pig—W.B.		......		21 5 0
	,, ordinary brands		20 5 0	,,	20 10 0
	,, Foreign, soft		......	,,	19 10 0
	Red		......		22 0 0
	Shot		......		23 0 0
	Dry White		......		27 0 0
SPELTER	(Cake)		£17 15 0	,,	18 0 0
ZINC	(Sheet)		......	,,	23 0 0
			Per Bottle.		
QUICKSILVER	(in bottles containing 75 lbs. each)		......		7 0 0
			Per Ton.		
REGULUS OF ANTIMONY	French Star		......		47 0 0

The metal market continues in a depressed condition, and a few forced sales have still further lowered the value of some of the leading articles.

IRON.—*Scotch Pig* remains steady, and with scarcely any change in price.

COPPER.—Quotations for *Foreign* are again lower, and the demand is small. *English* is likewise easier, sales of second-hand parcels being reported at 10½d. per lb.

TIN.—Not so much enquiry, and a few lots of very *fine Straits* have been sold at 117s. to 118s. cash; mixed lots fetching 116s. to 116s. 6d.

SPELTER.—No transactions, and the nominal prices are a trifle easier.

Copper Ores,

Sampled Jan. 15, and sold at Tabb's Hotel, Redruth, Jan. 30.

Mines.	Tons.	Purchasers.	Price. £	s.	d.
Great Wheal Busy	95	14	£1	17	0
	86	14	3	0	6
	66	9	2	15	6
	65	2	1	10	0
	64	9	2	15	6
	61	7	1	16	6
	58	14	2	16	6
	51	9	2	10	6
	43	9	3	10	6
	40	9	2	15	6
	36	3	6	5	0
	35	3	4	2	0
West Caradon	82	8	9	15	6
	76	11	6	12	6
	75	8	6	7	0
	73	10	5	12	0
	68	8	9	8	6
	55	8	8	14	0
	53	8	7	2	0
	35	2	1	15	0
Clifford Amalgamated ...	92	7	4	17	0
(United Mines)	91	14	2	15	6
	43	11	0	13	0
	42	11	2	7	0
	41	8	4	1	6
	40	6	2	19	0
	38	11	0	17	6
	35	11	1	11	0
	32	9	0	10	6
	28	3,8	3	19	0
	18	8	3	9	6
South Caradon	88	5,7	9	16	6
	73	7	9	7	6
	64	3	6	3	6
	51	2,3,7	15	2	0
	50	2,3,7	18	10	6
	48	4	6	6	0
	40	4	7	3	0
Fowey Consols............	80	6	6	8	6
	79	7	9	12	6
	78	2,6	5	16	0
	75	7	6	7	0
	48	7	6	12	0
North Treskerby	80	4,8	3	19	6
	69	4	3	12	0
North Treskerby	60	4,11	£3	10	0
	49	4	9	13	0
	44	8	2	13	6
Tywarnhaile	59	2,8	1	19	6
	50	7,8	2	9	6
	43	3,5,7,8	2	17	6
	42	5,7	2	17	6
	38	9	4	12	0
	37	8	1	19	0
	32	4	7	12	0
North Downs	71	4	7	6	6
	62	7	7	15	6
	61	3	10	1	0
	56	3	7	8	0
Wheal Polmear............	76	9	2	14	6
	51	11	4	2	6
	48	11	4	14	6
	45	6	7	19	0
Craddock Moor............	64	2	7	10	6
	63	3	7	3	6
	50	7	6	8	6
	20	2	4	0	6
St. Day United............	53	6	3	13	0
	46	6	5	13	0
	35	14	2	4	6
	30	11	1	18	6
East Crinnis	75	10	5	8	6
	62	3,7,10	4	8	0
South Crinnis	50	6	4	9	6
	45	7	4	16	6
Wheale Moyle	60	2,6	1	10	6
	8	8	5	18	0
Perran Mines...............	31	11	3	1	6
	26	11	3	9	0
Burra Burra	23	4	3	7	6
	16	8	1	15	0
	9	4	4	14	0
Gonamena	23	3	6	8	6
	8	9	3	19	6
Duchy and Peru	14	2,6	1	11	6
East Charlotte	14	14	2	1	6
Hender's Ore...............	7	6	1	18	0
Mines Royal Company	5	4	4	14	0
Wheal Cupid...............	3	8	10	16	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount. £.	s.	d.
Great Wheal Busy	700	1,929	3	6
West Caradon..................	517	3,747	1	0
Clifford Amalgamated	500	1,387	18	0
South Caradon	414	4,228	18	6
Fowey Consols	360	2,519	16	6
North Treskerby	302	1,366	19	0
Tywarnhaile	301	974	16	0
North Downs	250	2,029	11	6
Wheal Polmear	220	1,002	0	6
Craddock Moor	197	1,335	7	6
St. Day United	164	588	19	6
E. Crinnis and S. Par.......	137	679	13	6
South Crinnis	95	440	17	6
Wheal Moyle	68	138	14	0
Perran Mines	57	185	0	6
Burra Burra.....................	48	147	18	6
Gonamena	31	179	11	6
Duchy and Peru	14	22	1	0
East Wh. Charlotte	14	29	1	0
Hender's Ore	7	13	6	0
Mines Royal Company......	5	23	10	0
Wheal Cupid	3	32	8	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
2 Vivian and Sons.........	323 3¼	£1627	10	9
3 Freeman and Co.	417 1¾	3133	10	9
4 Grenfell and Sons	416	2480	7	0
5 Crown Copper Co.	75¾	523	11	8
6 Sims, Willyams & Co...	397	1963	2	6
7 Williams, Foster & Co..	740 1½	5057	11	10
8 Mason and Elkington.	619½	3665	18	4
9 F. Bankart and Sons..	418	1182	12	0
10 Copper Miners' Co......	168¾	906	12	2
11 Charles Lambert........	450	1502	12	0
12 Newton, Keates & Co..	—	—		
13 Alkali Co	—	—		
14 Sweetland & Co..........	379	959	4	0
	4404	£23,003	13	0

...ge Produce, 6½
...y of Fine Copper, 272 tons 1 cwt.

Average Standard ... £129 1 0
Average Price per ton £5 4 6

Copper Ores,

Sampled Jan. 22, and sold at Tabb's Hotel, Redruth, Feb. 6.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	111	6	£6 4 0
(Wheal Clifford)	103	2,7	5 6 6
	101	5,7	4 6 6
	100	3	5 1 0
	83	7	4 16 6
	62	4	7 11 0
	60	3	6 6 0
	58	5,7	5 9 0
	57	3	4 8 0
	48	4,7	7 8 6
	34	4	2 6 6
	22	2	4 3 6
	21	6	14 8 0
	20	2,6	4 5 6
(Consols)	56	5,7	7 5 6
West Seton	89	4,8	8 16 6
	88	4	7 7 0
	79	8	4 7 0
	71	7,10	6 4 6
	69	8	4 10 0
(Basset)	64	10	2 6 6
	59	4	7 5 0
	49	10	2 6 6
	45	8	5 2 6
Tincroft	118	2,6	0 15 0
	69	2	2 12 6
	54	10	2 10 6
	51	2	4 7 6
	49	14	2 8 0
	37	14	4 9 6
	25	10	8 11 0
	20	14	1 16 0
Wheal Basset	86	2,6	7 3 6
	80	5,7	5 16 6
	78	2	5 5 6
	70	8	10 8 0
	20	10	2 8 6
Wheal Seton	30	5,7,8	4 17 6
	8	5,7	1 7 6
(Pendarves)	81	5,7	4 11 6
	72	8,11	1 3 6
	55	2,6	0 2 6

Mines.	Tons.	Purchasers.	Price.
Whl. Seton (Pendarves)	53	7	£5 8 6
	20	3	2 12 0
	12	2	13 6 6
	126	3,8	2 6 6
	71	8	1 16 0
	57	8	6 12 0
	54	5,7	5 10 6
	19	14	2 14 6
	61	8	3 5 6
	51	6	4 6 6
	50	11	0 8 6
	43	3	4 14 6
	42	8	2 15 6
	41	6,11	3 11 6
South Frances	85	3,6	4 5 6
	67	12	6 10 0
	53	2,6	9 5 6
	21	11	4 0 6
	5	14	4 16 6
South Tolgus	93	5,7	8 13 6
	82	8	4 2 6
East Basset	57	4,6	4 17 0
	55	6	6 1 0
	28	4	9 17 0
Camborne Vean	68	5,7	4 15 6
	53	4	3 9 0
Dolcoath	47	10	4 3 0
	45	10	3 3 0
Stray Park	46	6	3 4 6
	23	5,7	10 7 6
South Crofty	29	3	1 7 0
	19	12	6 8 0
	14	10	3 14 0
West Tolgus	52	2,6,10	4 11 6
South Basset	50	11	2 8 6
Wheal Grenville	22	2,6	5 6 6
	15	2,6	11 2 0
Carn Camborne	15	14	7 2 6
	13	8	2 17 0
East Grenville	23	6	3 10 0
Wheal Trefusis	7	12	5 8 0
	3	10	4 12 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amalgamated	936	£5,314 11 6
West Wheal Seton	613	3,449 9 0
Tincroft	423	1,162 0 6
Wheal Basset	334	2,271 0 0
Wheal Seton	331	1,118 14 6
Condurrow	327	1,147 1 6
East Pool	288	907 18 0
South Frances	231	1,399 2 0
South Tolgus	175	1,145 0 6
East Basset	140	885 0 0
Camborne Vean	121	£ 507 11 0
Dolcoath	92	336 16 0
Stray Park	69	386 19 6
South Crofty	62	212 11 0
West Tolgus	52	237 18 0
South Wheal Basset	50	121 5 0
Wheal Grenville	37	283 13 0
Carn Camborne	28	143 18 6
East Wh. Grenville	23	80 10 0
Wheal Trefusis	10	51 12 0

EACH COMPANY'S PURCHASE.

	Tons.	£ s. d.
1 Mines Royal Co.	—	—
2 Vivian and Sons	327 17½	2,389 5 0
3 Freeman and Co.	372	1,574 12 0
4 Pascoe Grenfell & Sons	387	2,710 8 9
5 Crown Copper Co.	321	1,886 18 6
6 Sims, Willyams & Co.	600½	3,031 17 0
7 Williams, Foster & Co.	568	3,248 7 0
8 Mason and Elkington	742½	3,438 12 9
9 F. Bankart & Sons	—	—
10 Copper Miners' Co.	373 17½	1,364 0 3
11 Charles Lambert	177½	342 12 3
12 Newton, Keates & Co.	93	594 18 0
13 Alkali Co.	—	—
14 Sweetland and Co.	179	581 0 0
Total	4342	£21,162 11 6

Average produce, 5¾.
Quantity of fine Copper, 250 tons 12 cwt.

Average standard, £125 9s. 0d.
Average price per ton, £4 16s. 6d.

Copper Ores,

Sampled Jan. 29, and sold at Tabb's Hotel, Redruth, Feb. 13.

Mines.	Tons.	Pur-chasers.	Price.
Great Wheal Alfred......	86	8, 11	£2 0 6
	78	8	3 9 0
	61	8, 11	2 16 6
	60	4, 10	3 16 0
	54	8	1 16 0
	53	11	2 7 6
	51	11	3 6 6
	50	10	4 1 6
	47	4, 10	3 6 6
	31	8	1 13 6
	30	6	11 3 0
West Basset	74	3	4 14 6
	72	8	5 16 6
	71	8	4 6 0
	70	8	4 1 6
	61	8	5 4 0
	60	8	7 11 0
	42	2, 6	7 8 6
	33	10	6 12 6
	24	8	5 4 6
	11	14	3 14 6
Carn Brea	112	2	0 3 0
	61	4	5 0 6
	59	4, 5, 7	7 6 6
	46	4	2 17 6
	45	10	3 4 0
	39	11	4 12 0
	32	4	6 9 0
	25	10, 11	3 3 0
Levant........................	86	9	6 0 0
	83	14	1 18 6
	60	10	6 5 0
	57	2, 6, 10	6 1 6
	7	14	22 12 6
	2	14	18 12 6
Par Consols	71	5, 7	7 17 6
	70	5, 7	10 19 6
	69	6	7 1 0
	40	9, 14	1 12 0
	36	11	3 14 0
Pendeen Consols	98	6	2 12 6
	45	6	2 17 0
	33	6	0 18 0

Mines.	Tons.	Pur-chasers.	Price.
Pendeen Consols.........	30	6	£2 15 0
	6	6	8 16 6
Great South Tolgus	54	10	9 13 0
	52	4	6 2 6
	47	4	7 11 0
	45	8, 10	8 14 0
East Alfred Consols......	100	2, 6	3 19 0
	41	2	3 15 6
	32	6	6 13 0
Charlotte United	52	10, 11	5 13 6
	43	5, 7	9 5 6
	38	6, 8	7 7 0
	22	11	2 14 0
Prosper United............	73	6	5 19 0
	33	3	4 17 0
Copper Hill	45	6	1 18 0
	39	6, 8	6 17 0
	12	2	13 18 6
Botallack	39	14	5 12 0
	27	10	9 11 6
	22	7	4 18 6
Rosewarne United	45	11	5 9 0
	45	5, 7	8 12 6
West Fowey Consols ...	80	10	8 0 0
Treloweth	46	5, 7	6 11 6
	15	9	1 3 6
	14	6	12 15 6
Wheal Buller..............	36	11	2 11 6
	30	5, 7	10 0 6
Wheal Anna	27	2	2 5 6
	26	6	4 1 0
Wheal United Consols .	24	11	6 6 6
Rosewarne Consols......	18	6	7 19 0
	6	6	25 18 6
New Wheal Hender ...	16	8	5 16 0
	8	14	2 11 6
South Dolcoath...........	16	7	11 18 6
Great Work	13	14	7 0 0
Camborne Consols	11	8	9 1 6
West Tolvadden	5	9	3 8 6
	4	10	5 5 0
Trencrom	2	6	25 19 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Great Wheal Alfred	601	£1,982 13 6
West Basset......................	518	2,826 13 0
Carn Brea.........................	419	1,496 6 0
Levant	295	1,592 13 6
Par Consols	286	2,011 0 6
Pendeen Consols..............	212	550 13 0
Great South Tolgus	198	1,585 19 0
East Alfred Consols	173	762 11 6
Charlotte United	155	1,032 12 6
Prosper United	106	594 8 0
Copper Hill	96	519 15 0
Botallack	88	585 5 6
Rosewarne United	83	573 0 0
West Fowey Consols.........	80	£640 0 0
Treloweth	72	479 4 0
Wheal Buller	66	393 9 0
Wheal Anna......................	53	166 14 6
Wheal Unity	24	151 16 0
Rosewarne Consols	24	298 13 0
New Wheal Hender	24	113 8 0
South Dolcoath	16	190 16 0
Great Work	13	91 0 0
Camborne Consols............	11	99 16 6
West Tolvadden	9	38 2 6
Trencrom Mine	2	51 18 0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.
1	Mines Royal	—	—
2	Vivian and Sons	282	868 19 0
3	Freeman and Co.	107	509 14 0
4	Grenfell and Sons	311½	1,654 14 5
5	Crown Copper Company	167½	1,462 15 5
6	Sims, Willyams and Co.	665½	3,381 0 6
7	Williams, Foster & Co.	205½	1,761 18 5
8	Mason and Elkington...	682½	3,158 12 3
9	F. Bankart & Sons.......	126	582 15 0
10	Copper Miners' Compy.	486½	3,072 4 9
11	Charles Lambert	418	1,617 7 3
12	Newton, Keates and Co.	—	—
13	Alkali Company	—	—
14	Sweetland and Co.	183	758 7 0
		3624	£18,828 8 6

Average produce, 6½.
Quantity of fine Copper, 322 tons 18 cwts.

Average standard, £123 13s. 0d.
Average price per ton, £5 4s. 0d.

Copper Ores,

Sampled Feb. 5, and sold at the Royal Hotel, Truro, Feb. 20.

Mines	Tons.	Purchasers.	Price.
Devon Great Consols...	134	7	£4 2 6
	120	2	3 9 6
	118	5,7	1 16 6
	117	2,7	3 18 6
	112	2	3 14 6
	111	2	3 17 0
	109	7	3 12 6
	108	3	1 9 6
	106	7	3 18 6
	105	2	3 15 0
	96	2,7	3 15 0
	94	14	2 18 6
	86	2,7	2 15 6
	85	11	2 12 6
	83	11	2 13 6
	82	4	11 5 0
	74	11	1 12 6
	71	2	2 18 0
	63	4	3 4 0
	58	11	2 13 0
	54	11	1 10 0
	53	2	3 14 6
	52	4	10 13 0
	46	14	2 13 0
	34	4	2 16 6
	33	4	4 17 6
Marke Valley	110	2,3	4 19 6
	101	2,4	4 4 6
	70	9	4 19 0
	65	14	3 15 6
	41	2	3 4 6
	34	14	3 7 6
East Caradon	92	6	5 6 0
	85	11	4 18 0
	83	2	4 16 0
	63	6	8 16 6
	52	6	11 7 0
Phœnix Mines	77	9	3 0 0
	75	8	3 10 0
	61	5,7	9 5 6
	60	2,10	3 19 6
	35	6	7 7 0
	25	8	11 16 6
Wheal Crelake	71	8,12	5 19 0
	63	4	3 2 0
Wheal Crelake	53	4	£5 14 0
	50	3	3 3 0
	48	3,10	3 12 0
	40	10	3 12 0
Great Wheal Martha ...	134	2,6	1 9 0
	67	2,6	1 19 0
	62	2,6	1 7 0
	34	2,6	4 5 6
Wheal Edward...........	84	11	2 6 6
	72	2,5,7,12	3 2 6
	64	8	2 17 6
	28	3	1 14 6
	23	10	3 1 6
	22	7,10	4 1 6
North Wheal Robert ...	68	10,12	6 10 6
	64	2,7	13 10 6
	52	2	2 11 6
	42	8	4 3 6
	14	10	19 12 0
Bedford United...........	111	6	5 0 0
	109	6	5 7 0
South Bedford	72	8	1 14 0
	59	14	2 8 6
	19	12	7 13 0
Wheal Emma	64	2,3	3 12 0
	47	5,7	9 8 6
	34	4	2 12 0
Sortridge Consols	72	8	5 4 6
	61	10	7 16 6
Wheal Arthur	68	10	2 1 0
	62	5,7	3 6 6
Wheal Friendship	87	2,7	7 9 6
	32	2,7	9 19 0
Harvey's Ore...............	42	6	1 5 0
	40	6	1 9 6
Okel Tor.....................	80	8	2 9 0
Western Counties Reg. .	65	4,6	2 14 0
Devon and Cornwall ...	50	8	2 3 0
Brookwood.................	47	4	5 0 0
	3	2,7	18 10 6
Hawkmoor.................	31	7	6 3 0
Collacombe.................	30	6	5 2 6
Fursdon	25	6,7	7 15 0
Bedford Consols	21	9	2 9 6
Tavy Consols	13	9	2 16 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Devon Great Consols	2204	£7986 17 0
Marke Valley	421	1812 6 6
East Caradon...................	375	2448 13 6
Phœnix Mines.................	333	1850 13 0
Crelake	325	1394 6 0
Great Wheal Martha.........	297	554 0 0
Wheal Edward	293	812 19 6
North Robert	240	1892 19 0
Bedford United..................	220	1138 3 0
South Bedford	150	396 1 6
Wheal Emma.....................	145	761 15 6
Sortridge Consols	133	853 10 6
Wheal Arthur..................	130	£ 345 11 9
Wheal Friendship...........	119	968 14 6
Harvey's Ore	82	111 10 0
Okel Tor	80	196 0 0
Western Counties Reg. ...	65	175 10 0
Devon and Cornwall.........	50	107 10 0
Brookwood	50	290 11 6
Hawkmoor......................	31	190 13 0
Collacombe	30	153 15 0
Fursdon	25	193 15 0
Bedford Consols.............	21	51 19 6
Tavy Consols	13	36 14 6

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Mines Royal..................	—	£ —
2 Vivian and Sons............	1324½	5251 14 6
3 Freeman and Co..........	297	840 6 6
4 Grenfell and Sons..........	544	3056 14 9
5 Crown Copper Co..........	162	771 7 6
6 Sims, Willyams & Co.......	761½	3756 1 0
7 Williams, Foster & Co....	808	3941 10 9
8 Mason and Elkington....	515½	£1930 16 0
9 Bankart and Son	181	666 4 0
10 Copper Miners' Co........	305	1578 3 6
11 Charles Lambert...........	523	1411 18 0
12 Newton, Keates & Co....	106½	634 13 6
13 Alkali Co. (Limited)......	—	—
14 Sweetland and Co.........	218	885 6 0
Total...........	5832	£24,724 16 0

Average Produce, 5⅜.
Quantity of Fine Copper, 316 tons 2 cwts.

Average Standard, £128 19 0
Average Price per ton, 4 5 0

We cannot include the last Cornish sale of the month, as it does not take place until our day of publication, the 27th instant.

Copper Ores,

Sampled Jan. 15, and sold at Swansea, Feb. 14.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Cuba	100	11⅞	6	£10	7	0
	95	12¼	7	10	11	6
	93	12⅝	6,7	10	12	0
	90	12	6,7	10	14	0
	85	12½	6	10	19	0
	4	74½	5	62	2	0
	78	12½	7	10	17	6
	45	20¼	2,7	17	12	0
	44	21⅛	2,7	18	13	0
	6	81	6	70	15	0
Berehaven	115	11½	7	10	4	0
	89	11⅛	2	10	4	6
	114	10	6	8	16	0
	84	10½	2	9	1	6
	80	10⅜	2	9	1	6
	68	10⅛	14	9	7	6
Knockmahon.	93	10½	3	8	19	6
	66	11⅞	3,6	10	7	0
Knockmahon ..	64	11¾	3,6	£10	17	0
	70	11¼	3	9	18	0
	31	9⅞	3	8	12	6
	85	9⅛	3	7	19	0
	55	5⅛	12	4	11	6
Ookip	54	33½	10	30	10	6
	53	33½	5	30	7	6
	50	33¼	5	30	7	6
	49	33¼	5	30	6	0
Wh. Maria	48	23½	1	21	4	6
	42	23¼	2	21	0	6
Genoa	109	7¾	7	6	13	6
	19	6½	6	5	8	0
	13	18	6	16	0	0
	11	8¾	6	7	10	0
	2	4¾	5	3	12	6
	1	14½	6	12	15	0
Glasgow Slag.	148	2½	5	1	5	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Cuba	639	£8,042	6	6
Berehaven	550	5,212	0	6
Knockmahon	464	4,067	18	6
Ookip............................	206	6,261	13	6
Wheal Maria	90	£1,901	15	0
Genoa	155	1,140	13	6
Glasgow Slag................	148	185	0	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Copper Miners' Comp...	48	£1,018	16	0
2 Freeman and Co.	339½	4,087	13	6
3 P. Grenfell and Sons ...	344	3,143	11	0
5 Sims, Willyams and Co.	306	5,053	19	6
6 Vivian and Sons	505	5,441	3	0
7 Williams, Foster & Co...	532¼	5,528	17	0
8 Mines Royal Company	—	——		
10 Mason and Elkington ..	54	1,648	7	0
12 C. Lambert	55	251	12	6
14 Sweetland, Tuttle & Co.	68	637	10	0
16 Jennings & Co.	—	——		
Total......	2,252	£26,811	9	6

Copper Ores,

Sampled January 22, and sold at Swansea February 11.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Cobre	1116	11¼	3	£9	15	6
	95	11¼	5	9	16	0
	94	11½	6	9	17	0
	91	11⅛	3	10	0	6
	81	11⅜	3	10	1	0
	55	21¾	5	19	5	0
	54	21⅛	3	18	10	6
	42	21	3	17	12	6
	9	64	5	52	6	0
	1	22⅜	3	18	18	0
	99	11	6	9	11	0
	98	11¼	6	9	9	0
	97	11⅛	6	9	5	0
	96	10⅜	3	9	3	6
	96	10⅞	3	9	3	6
	94	11	3	9	9	6
	10	62⅜	5	53	2	0
Berehaven......	128	10¼	14	8	14	0
	108	10⅝	7,14	8	19	0
	102	9¾	6	8	3	0
Berehaven	98	10⅞	7	£9	3	6
	79	10¾	7	9	1	0
	44	11¼	2,6	9	9	0
Wheal Maria.....	50	23¾	5	21	0	0
	47	23¾	5	20	12	0
	46	24¼	5	21	10	0
	45	23	2	20	3	0
Ookip.	53	34	3	29	15	0
	47	34	7	29	14	6
	32	33¼	2	29	11	0
Spectakel	33	24	1	21	1	0
Knockmahon ...	104	11⅛	2,7	9	8	0
	76	12⅜	5	10	10	0
Californian	66	15⅛	3	13	0	0
	64	15⅛	3	13	9	6
	62	24¾	3	21	12	6
Gt. Northern of So. Aus.	63	19½	1	16	7	6
African	1	15¾	5	13	5	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Cobre	1,116	£12,920	18	6
Berehaven	559	4,941	8	0
Wheal Maria...............	188	3,913	19	0
Ookip	132	3,918	5	0
Spectakel	33	694	13	0
Knockmahon	180	£1,775	12	0
Californian	192	3,061	3	0
Great Northern of So. Australia	63	1,031	12	6
African........................	1	13	5	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Copper Miners' Co.......	96	£1,726	5	6
2 Freeman and Co.........	151	2,549	1	0
3 P. Grenfell and Sons...	804	10,872	13	6
5 Sims, Willyams & Co.	389	6,809	18	0
n and Sons	512	4,733	18	0
ms, Foster, & Co.	330	3,982	2	0
14 Sweetland, Tuttle, & Co.	182	1,596	18	0
15 Charles Lambert.........	—	——		
16 Jennings & Co............	—	——		
Total	2,464	£32,270	16	0

Lead Ore Sales.

Dates.		Mines.	Tons.	Price per Ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Jan.	24.	Laxey	100	16	19	0	Sims, Willyams and Co.	1695	0	0
,,	25.	Llanfyrnach	40	11	12	0	ditto	464	0	0
,,	28.	Isle of Man Mining Co.'y.	100	20	18	0	ditto	2450	12	0
		,,	24	15	0	6	ditto			
		Minera	100	12	12	6	Locke, Blackett, & Co.	4683	5	0
		,,	100	12	12	6	ditto			
		,,	90	12	12	6	ditto			
		,,	80	12	15	6	Panther Company			
,,	30.	Dyliffe	30½	12	8	6	A. Eyton	757	18	6
		,,	30½	12	8	6	Walker, Parker & Co.			
,,	31.	Wheal Mary Ann	60	24	2	6	Stock and Co.	2004	7	1
		,,	55	10	12	6	Treffry's Trustees			
Feb.	3.	East Logylas	70	12	10	0	Mining Co. of Ireland	875	0	0
		Glogfach	60	15	0	0	Sims, Willyams and Co.	900	0	0
		Cwmystwith	100	12	4	0	ditto	1220	0	0
		Goginan	8	15	1	0	ditto	834	15	6
		,,	45	15	17	6	Walker, Parker & Co.			
		Cefn Brwyno	60	11	18	6	ditto	715	10	0
,,	4.	Chiverton	50	18	0	6	Par Smelting Company	1304	12	6
		,,	35	11	10	6	ditto			
,,	5.	Penpompren	20	13	1	0	Sims, Willyams and Co.	261	0	0
,,	8.	Carmarthen United	27	12	7	0	ditto	333	9	0
,,	11.	Keswick	25	12	5	0	Shield and Dinning	306	5	0
,,	13.	Talargoch (Maesyrerwddu)	45	13	4	0	A. Eyton	952	18	6
		,, (Coetia Llys)	27	13	5	6	Walker, Parker & Co.			
		Deep Level	25	12	15	6	ditto	319	7	6
		Rhosesmor	86	12	15	0	Newton, Keates and Co.	1196	10	0
		Orsedd	25	12	18	6	Walker, Parker and Co.	323	2	6
		Bryn Gwiog	45	12	16	0	A. Eyton	576	0	0
		Parry's Mine	35	12	16	0	Newton, Keates and Co.	448	0	0
		Kilmory	4	12	7	6	Walker, Parker & Co.	49	10	0
		North Henblas	8	12	1	0	Newton, Keates & Co.	124	10	0
		,,	2	14	1	0	Walker, Parker & Co.			
		Nant-y-Iago	12	12	0	6	ditto	144	6	0
		Holywell Level	10	14	10	6	ditto	145	5	0
		Llangynog	20	12	10	0	ditto	250	0	0
		Brusenpiano Mine	17	9	12	6	Newton, Keates & Co.	182	0	0
		,,	3	6	2	6	ditto			
,,	14.	Isle of Man Mining Co.'y.	100	14	7	0	—	1435	0	0
,,	15.	Llanfyrnach	15	11	5	0	Panther Company	277	10	0
		,,	15	7	5	0	ditto			
,,	17.	Frongoch	160	11	19	0	Panther Company	1912	0	0
		Cwm Erfin	30	15	1	0	R. Michell & Son	752	10	0
		,,	20	15	1	0	Walker, Parker & Co.			
		Dyliffe	120	12	18	0	ditto	1548	0	0

Black Tin Sales.

Date.	Mines.	Tons	c.	q.	lbs.	Price per ton £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Jan.	1. Great Wheal Busy	10	9	1	15	—			Carvedrras	626	15	3
„	5. Wheal Tremaine	5	9	1	11	75	12	6	Mellanear	793	11	3
	„	5	13	0	17	68	5	0	Treriffe			
„	25. Drake Walls	3	5	0	0	71	0	0	Harvey & Co.			
	„	3	5	0	0	71	0	0	Calenick Co.			
	„	6	5	0	0	67	5	0	Enthoven & Sons	1302	6	3
	„	6	5	0	0	67	5	0	Calenick Co.			
„	27. East Wheal Lovell	1	5	3	8	69	10	0	Chyandour	89	14	6
	Treworlis	3	12	3	0	67	0	0	Ditto	259	0	0
	„	0	6	0	0	51	0	0	Ditto			
„	28. Great Wheal Busy	12	13	2	6	—			Carvedras	764	11	5
	Bottle Hill	4	15	3	26	67	0	0	——			
	„	0	3	1	17	67	0	0	——	339	14	8
	„	0	3	1	17	40	0	0	——			
„	29. St. Day United	57	10	5	10	—			——	3468	8	0
	Basset & Grylls	22	13	3	25	—			——	1492	17	0
Feb.	1. Gurlyn	4	11	0	0	66	0	0	Chyandour	300	6	0
„	5. Garlidna	8	18	3	11	70	5	0	Bissoe Company	758	16	4
	„	2	4	1	3	59	0	0	Ditto			
„	6. North Roskear	6	6	1	27	65	10	0	Treriffe	414	5	2
	Ashburton United	5	17	2	14	70	14	0	Harvey & Co.			
	„	5	18	3	10	70	13	0	Enthoven & Sons	1245	3	3
	„	5	15	3	12	70	14	6	Calenick Co.			
„	8. Penhalls	5	1	0	7	—			Carvedras	339	16	4
	Wheal Kitty	9	4	0	18	—			Ditto	570	17	11
	Great Wh. Fortune	15	4	2	18	—			——	1124	18	6
„	11. Redmoor	4	0	0	0	67	0	0	——	268	0	0
„	12. Wendron Consols	19	1	0	13	—			Chyandour	1290	16	0
„	15. Great Wheal Vor	21	10	2	4	—			——	1573	2	0
	Wheal Union	2	16	0	1	64	15	0	Trethellan Co.	181	6	6

Tin ores being sold by private contract, the particulars are not generally published or accessible. We hope, however, to be able to provide monthly a tolerably complete list of the sales of this metallic ore: the above list gives no idea of the real sales.

Sundry Copper Ore Sales.

Sold at Liverpool, by Mr. James Hallows.

Date.		Tons.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Jan. 29.	Lot 1 (ex *Hidalgo*)	55	23	15	0	Williams, Foster & Co.			
	2 „	55	23	15	0	ditto			
	3 „	55	23	15	0	ditto			
	4 „	55	23	15	0	ditto	8978	15	0
	5 „	55	22	15	0	ditto			
	6 „	55	22	15	0	ditto			
	7 „	55	22	15	0	ditto			

Sold at Liverpool, by Mr. James Lewis.

Feb. 4.	Laxey (ex *Jane & Agnes*)	58	4	7	6	C. Lambert	333	4	6
	Ditto „	11	7	4	6	Newton, Keates & Co			
	Var (ex *John & Mary*)	33	9	6	3	James Radley, Jun.	307	6	
	Worthing (regulus)	15	51	9	0	Sims, Willyams & Co.	1542	0	0
	Ditto „	15	51	7	0	ditto			

Sold at Liverpool, by Mr. James Hallows.

„ 13.	Lot 1 (ex *Polestar*)	72	19	16	0	Sims, Willyams & Co.			
	2 „	72	19	10	0	Copper Miners' Co.			
	3 „	72	19	7	6	Ditto, and Newton & Co.	8471	8	0
	4 „	72	19	8	6	Copper Miners' Co.			
	5 „	72	19	14	0	Sims, Willyams & Co.			
	6 „	72	19	18	0	C. Lambert			

Sold at Liverpool, by Mr. J. Pitcairn Campbell.

„ 21.	Lot 1 (ex *M. Banfield*)	33	1	17	6	J. Keys and Son			
	2 (ex *Triglaf*)	35	3	4	6	Ditto	572	4	0
	3 (ex *John & Mary*)	37	10	15	0	Newton, Keates and Co.			

Sold by the Parys Mines Company.

„ 18.	Lot 1 (copper ore)	400	4	18	0	——			
	2 (cop. precipitate)	42	16	4	6	——	3052	1	0
	3 „	38	5	19	0	——			
	4 „	20	9	4	6	——			

THE

MINING AND SMELTING MAGAZINE.

APRIL, 1862.

On the Mexican Method of Amalgamation.

BY JAMES NAPIER, JUN., F.C.S.,
Late Chemist and Assayer of the Guanaxuato Mint, Mexico.

§ III.—MATERIALS USED IN THE PATIO.

THE materials absolutely necessary for the reduction of silver ores in the Patio are but few, namely—sulphate of copper, or *magistral*, common salt, chloride of sodium and mercury. But the various modifications introduced have led to the employment of other ingredients, such as precipitated copper, copper amalgam, and fine amalgam.

1.—*Magistral, or Sulphate of Copper.*—This is manufactured from the sulphide of copper, mines of which exist in many parts of Mexico; but, the district of *Tepezala*, about 18 or 20 leagues south-east of Zacatecas, and about 65 from Guanaxuato, perhaps supplies the largest quantities of this ore for the manufacture of the sulphate. The following shows the per centage of copper contained in various samples from this district:—

Copper per. cent.	
13.00	
7.47	
13.75	
9.00	
12.50	=10.32 mean percentage of copper.
10.50	
8.60	
9.40	
8.73	

There are many much richer samples found in this locality, but these give a very fair idea of the class of ores generally sent to the various reduction works for the manufacture of the sulphate.

The sulphide of copper when brought to the haciendas is, like the silver ore, first reduced to a coarse powder in the stamping mill, and afterwards ground to a fine powder in the arrastres; but in grinding this, much more is charged to the arrastres at once, and they are discharged twice in the 24 hours. The ground ore is removed from the arrastre to a small enclosure, where the water, with which it was ground, is allowed to evaporate spontaneously, and where it

is allowed to remain exposed to the air for a length of time—sometimes two years—before being calcined. It is stated the longer it is exposed to the air, the more sulphate will it yield; I have examined various samples which had been exposed for a length of time for sulphates, but have never found any.

The furnaces in which this is calcined are called *comalillos*. They have a double hearth; the roof is almost quite flat; and the fire place is in the centre, and runs longitudinally, so that the flame plays sideways. About eight arrobas of the ground ore (having previously had a few handfuls of common salt mixed with it) is charged on each hearth. The fire is then gradually increased, and the ore kept almost constantly stirred for the space of from six to eight hours, when the doors and other openings are closed to exclude the air. When the whole is sufficiently cold to ensure no further calcination, the ore is drawn through holes in the bottom of the furnace into a place made for its reception.

The percentage of sulphate of copper obtained by this method of calcination depends very much on the care which has been bestowed on the operation by the workmen. The following table gives the details of this operation as obtained in a few of the reduction works in Guanaxuato.

Name of Haciendas.	Sulphates per cent.		Total per cent. of sulphates availed of	Copper not availed of		Ore before calcining.
	Copper	Iron.		as sulphide.	as oxide.	
San Joaquin	40.99	9.73	50.72	4.50	2.11	15.30
,, Nicolas	20.50	12.38	32.88	2.50	.23	7.83
Granaditas	34.37	6.95	41.32	3.78	2.47	14.00
Salgado	24.64	7.40	32.04	—	2.50	8.00
Pardo	33.18	6.75	39.93	3.00	3.50	12.80
Pastita	31.62	9.05	40.67	.70	.15	8.75

In this table I give the amount of sulphate of iron as well as of the copper, because it is certain that the sulphate of iron also acts in the process of reduction, although not so perfectly as the sulphate of copper. A little of the copper given above as sulphate, will be in the state of chloride, formed by the decomposition of the small portion of salt added to the ore before calcination.

In some districts sulphate of iron is mixed with the sulphide of copper previous to calcination. By doing this, ores containing considerable quantities of carbonate and oxide of copper may be used for the manufacture of magistral.

The method employed by the amalgamators to know good from bad magistral, or rather to know the strength of it, is very rude. They take a small portion of the calcined ore in the hand; then gradually immerse the hand in water, and from the intensity of the heat given out, they judge of the quantity of sulphate the sample is likely to contain, and how much will have to be used in the process of reduction. They also like to employ the magistral as soon as possible after calcination as possible, as by standing it absorbs moisture from the atmosphere, and a larger quantity is required.

All the sulphate of copper produced in the "*apartado*"* of the mint, from the precipitation of the sulphate of silver by copper plates, is used in the reduction works in place of calcined copper pyrites. In this case it is easy to calculate how much must be added to a *torta*, and in using this torta is not augmented so much in bulk as when calcined pyrites is used.

2.—*Salt.*—There are various places in the Republic of Mexico where this article is obtained, but the principal localities are *Penon blanco* and *Salinas*. The former contains both salt lakes and springs; the latter were discovered by an English gentleman, Mr. Pollard, who was employed at this locality in extracting the salt from the earth *(Saltierra)* of the lakes. The following analysis made at the *Ecole des Mines, Paris*,† is of the salt earth from Penon blanco.

Chloride of Sodium	19.00	soluble in water.
Sulphate of Soda	2.20	
Carbonate of Lime	13.60	insoluble in water.
,, Magnesia	1.60	
Oxide of Iron	9.80	
Clay and Sand	46.20	
Water and Organic matter	7.60	
	100.00	

This class of salt earth was formerly used without refining in the reduction works of Zacatecas, but the augmentation in the bulk of the tortas in consequence of so much having to be added for the purpose of obtaining the necessary amount of chloride of sodium, was very inconvenient, and its use has consequently been given up. The quantity of chloride of sodium contained in the purified salt from Penon blanco averages from 80 to 85 per cent., the rest being principally sulphate of soda.

In the district of *Salinas* the salt is also found in springs. Here English and German workmen are employed to extract the salt, which they do by evaporation in large pans. The following are analyses of salt from this district, and such as is sent to the various reduction works:—

	No. 1.	No. 2.	No. 3.	No. 4.
Chloride of Sodium	90.422	91.141	86.853	96.623
,, Magnesium	2.520	2.538	.044	.008
,, Calcium	1.310	1.574	.125	.114
Sulphate of Potash	3.556	3.141	.029	trace
,, Soda	—	—	12.949	3.255
,, Lime	2.192	1.606	—	—
	100.000	100.000	100.000	100.000

The purest salt that is met with in Mexico is sea salt, which I have found to contain, on various occasions, as much as 98.50

* The name given to the department for separating gold from silver.
† See Duport *De la production des Metaux précieux au Mexique.*

per cent. of chloride of sodium; but the great cost of carriage of this salt from the coast to the interior, makes it too costly to be generally used in the reduction of silver ores.

3.—*Mercury*.—This metal, the consumption of which is very large, is almost entirely imported, although it exists in many localities in Mexico. I have seen beautiful specimens of cinnabar—red sulphide of mercury—from Mazapil, and also from the Gigante near Guanaxuato, where some years ago a company was projected for the reduction of the ores; but works were never established, why I do not know. However, considerable quantities of mercury have, from time to time, been obtained from these mines. The district of El Doctor, about 150 miles to the north of the city of Mexico, has also yielded a certain quantity of this metal.

4.—*Lime*.—This is not a necessary ingredient in the Patio amalgamation. It is only used when an excess of magistral has been employed, and is then added in a caustic state, its object being to precipitate the excess of copper employed. Wood ashes are frequently added for this purpose instead of lime.

5.—*Copper Precipitate*.—In many of the reduction works this is used in preference to lime for counteracting the action of an excess of sulphate of copper added to a torta, which it does by reducing the protochloride of copper to the state of subchloride. It is prepared by suspending a mercury bottle in a weak solution of sulphate of copper, when the copper is precipitated in the form of a very fine powder. The use of copper precipitate in the Patio amalgamation was first proposed by Mr. Louckner, who also in conjunction with Mr. Henry Mackintosh, obtained a patent in Mexico for the use of *Copper Amalgam* in the tortas. The object of this was to save mercury; and if used skilfully it no doubt would; the patent, however, was evaded in many instances by using precipitated copper instead of amalgam. The amalgam used by Messrs. Louckner and Mackintosh, contained about 30 per cent. of copper. *Zinc amalgam* is also at times used with good results.

§ IV.—TREATMENT OF THE GROUND ORE (LAMA) IN THE PATIO TO OBTAIN THE SILVER.

The *Patio* is a large court yard well paved with flags, carefully cemented together to prevent, as much as possible, the mercury from passing between them. It is made on a slight incline, so that superfluous water, from rain, &c., may run off easily.

The ground ore from the arrastres is collected in a place called a *cajete* until it reaches a sufficient quantity to form a *torta* or heap—which generally contains from 50 to 80 montones—60 being the general size. The monton, however, varies in different places, as under—

In Guanaxuato, a monton contains	32	quintals.*
,, Real del Monte / ,, Pachuca and Saco	30	,,
,, Zacatecas and Sombrerete	20	,,
,, Fresnillo	18	,,
,, Bolanos	15	,,

* About 22 quintals make one ton.

When the necessary amount has been collected in the cajete, it is removed to a space prepared for it in the body of the Patio. This is an inclosure about 30 feet in diameter, made by piling two or three rafters on each other, and securing them in their place by large stones; the joints being made good by horse-dung. The lama should not be much more than a foot thick; for the thinner it is, the quicker will the operation of reduction go on. Here it is allowed to remain till as much water evaporates from it as to leave it rather a thin mud. This condition being arrived at, the salt is added (which operation is called *Ensabmorar)* in the proportion of from three to five per cent. on the weight of the ore; this, however, will depend somewhat on the quality of the salt used, and on the nature of the ores under treatment, but I now speak of salt such as that referred to in the analyses given. It is well known that those who use the most salt, up to a certain point, will get out the silver in the shortest time. Some amalgamators will never use more than 3 per cent. salt, although they are quite aware the operation would be completed six or eight days sooner had 5 per cent. been used; but, the time gained will not compensate for the extra salt used. My friend Don Juan B. Castelazo added by mistake to a torta double the quantity of salt necessary; and the consequence was that the operation was concluded in 10 days instead of about 25—the usual time required for ordinary ores.

When the requisite quantity of salt has been added, the torta receives a *repaso* or *treading* (which will be described further on). It is then allowed to rest till the following day, when the whole of the salt ought to be in solution, and thoroughly mixed with the lama.

Incorporar, (addition of Magistral and Mercury).—The day after the salt has been added, they proceed (after bringing the torta to a proper consistency with water), to add the necessary quantity of *magistral*. If this be of an average quality, for instance like that given in the preceding analyses, it is added in the proportion of from half to three-quarters per cent. on the ore, or about an arroba to each monton of ore in the torta. It is thrown as evenly as possible over the whole surface of the mass by means of wooden shovels; and when the whole has been added, the mules are admitted to *repassar—tread*—for about an hour for the purpose of mixing the whole as thoroughly as possible. When this has been completed, the mercury is then added in the proportion of from 3½ to 4 lbs. to every mark (half pound) of silver contained in the torta. This mercury is introduced in a very fine shower, by being pressed through a linen sheet so as to divide the particles as much as possible. The torta, when the mercury is added, should not be too wet, otherwise the mercury would be apt to collect into large globules again;—neither should it be too dry, as the mercury in that case would become too much divided, and thus cause a larger loss than necessary in washing;—it should be of such a consistency, that the animals can, in treading, go through it with comparative ease, and yet leave the marks of their feet when removed. Immediately after the addition of the mercury the whole is again trodden for about four or five hours, for the purpose of incorporating as perfectly as possible the whole mass.

When pure crystallized sulphate of copper is employed, instead of common calcined pyrites, there is added from 10 to 14 lbs. for each monton of ore in the torta.

When the magistral and mercury have been added, and a repaso given, the torta may be said to be in working order; and it only remains for the *azoguero* or amalgamator to watch attentively its daily progress by repeatedly taking out *tentaduras*, samples:—the colour and general appearance of the mercury being the only guide to the whole operation.

A short time after the incorparo, the azoguero takes out a tentadura from the torta; washes away the earthy particles, and carefully examines what remains, which is composed of *polvillos*—metallic sulphides—and mercury. If the latter be rubbed with the thumb, or pressed through a piece of leather, but very little amalgam will remain. The colour of the mercury, in this case, is only taken notice of; and if it has altered a little from its natural colour, with a slight tinge of yellow, it is a sign that sufficient magistral has not been added; or if the mercury be divided into small particles it is a similar sign. If it partakes of a lead or deep grey colour, it is evident that an excess of magistral has been added, and the torta, in such a state, is said to be *caliente*—hot—which is very prejudicial, and causes an unnecessary loss of mercury. For this reason it is always better to err in adding too little than too much magistral. If the right quantity required be put upon it at first, it is a great object gained, as the torta at once falls into good working order and goes on, barring unforeseen accidents, with but little trouble to the end of the operation. When a torta is in good working order, the surface of the mercury is of a distinct light grey colour.

The day after the incorparo (should the magistral have been added in proper proportion), a very different appearance is presented in the tentadura. There is found collected mercury which when pressed by the thumb yields amalgam of silver; and what was in the first trial *desecho*—broken-up mercury—appears now as what is termed *limadura de plata*, of a whitish colour, and in the form of thin plates or leaves which, if rubbed with the thumb, will be found to consist of dry silver amalgam called *pasilla*. It is from the appearance of this that it is known when the operation is going on well. If pasilla be formed in a very short time after the ingredients have been added, it is certain they have been added in proper proportions.

To make a tentadura, about 1 lb. of the lama taken from various parts of the torta, is put into a jicara, and slowly washed in water contained in a convenient vessel. The jicara is gently moved about in a peculiar manner so that the lighter part only is washed away, leaving in the jicara the *limadura de plata*, (small leaves of amalgam); the mercury with its *lista*, or tail; and a portion of the polvillos, or heavier metallic sulphides of iron, &c. There is now added to the jicara about a tea-cup full of clean water; when it is inclined to one side in the hand, and a gentle but peculiar movement given to the water so as to arrange the contents of the jicara in the following order:—The limadura or broken up *lis* of mercury should occupy the first or upper part; the metallic portion of the ore should be below this; and, last of all, the mercury and amalgam as a large

globule. As I have stated before, the limadura is the most important part, and is inspected first; this is done by holding the jicara in the right hand in an inclined position, and rubbing the limadura with the thumb of the left hand, at the same time observing with great care its colour—the facility with which it can be converted into amalgam by the friction—and of the consistency of the resulting amalgam, that is to say, whether it contains a large or a small amount of mercury. The metallic portion, or povillos, is not of much importance, as the state of the amalgamation cannot be judged of from it. The globule of mercury at the bottom is lastly examined as to the colour, and the quantity of amalgam which it contains is ascertained by pressing it with the thumb on the side of the jicara.

These tendaduras are commonly taken from the surface and interior of the torta. The surface is always the most forward from its being most exposed to the action of the air and sun. Three tentaduras, or trials, are made of each torta daily; one in the morning before commencing to tread; one after it has been trodden for some time; and a third after the treading is finished.

When the operation approaches conclusion, that is to say, when nearly the whole of the silver capable of being taken up has been extracted, the limadura becomes *weak*, and upon being rubbed with the thumb shows but little amalgam. When it ceases to do so altogether, feels soft, and combines into small globules which run down to the bottom of the jicara, the amalgamation may be considered finished or *rendido*. However, in some cases, a torta may show the signs in this respect of being finished, when in reality it is not; for this reason, the *asciento*, (metallic portion, or polvillos, remaining in the bottom of the jicara,) is also examined by extending it out over the jicara, and rubbing the small prills collected there with the finger. If these unite into running mercury, then there is no doubt about the operation being finished; but should they form dry amalgam, it is not so, and the operation must be continued until such is the case.

If the *beneficio* (amalgamation) be low or cold, these signs are deceptive; consequently it is better to carry the torta *rather hot* than *cold*. At the present day the amalgamators, besides being guided by the above signs, also make an assay of the torta, by taking as average a sample as possible from the heap—washing it and collecting the whole of the mercury and amalgam, and having it assayed. By this means it can be easily calculated how much silver the whole of the mercury present ought to contain.

Treading; and turning over the Torta.—The operation of treading is carried on almost exclusively by mules or horses; and it is repeated every other day until the end of the operation. One mule to every two montones* is about the number employed. They are tied together four abreast, and blinded, and a man stands in the centre of the torta, holding a halter attached to the animals to guide and direct them through the mass. They first commence to tread at the edge or border of the torta, and very gradually work into the centre,

* A monton of 32 quintals.

which ensures the whole mass being thoroughly trodden. The operation lasts from about 6 o'clock in the morning till about 1 or 2 in the afternoon. Besides this treading, the tortas are also turned over twice a week by men, by means of wooden shovels. This is done on one of the days of the treading, and is commenced immediately on the removal of the animals from the tortas.

Animals are kept exclusively for the purpose of treading; and very frequently, when they become old and die, a ball of amalgam, weighing at times many ounces, is found in their stomachs. This is easily accounted for, for when they come from a torta they often commence to lick themselves, probably for the salt which may adhere to their bodies, to which also a considerable quantity of very finely divided amalgam may have attached itself. This latter passes into the stomach where, in the course of years, it accumulates into a large piece. These pieces of amalgam are extremely heavy and solid, and vary in size from a small nut to a large egg. The animals, as soon as they have finished treading, are well washed in a large tank of water.

It is believed by many that no means of repaso or treading, except that of animals, can be effectual, the reason assigned being that animals have the power of imparting or exciting a slight electrical action in the mass. This, however, has been entirely disproved by some amalgamators using machines in place of animals, and obtaining equally good results. I have no doubt machines will, before long, be entirely used, instead of animals, for this purpose.

Washing.—Where the amalgamation is considered complete, some amalgamators, previous to washing the torta, add to it a portion of fresh mercury which is called bano—bath—for the purpose of collecting as much as possible the finely divided amalgam. However, others prefer using a larger quantity of mercury in the torta, from the commencement and adding no bano. The next thing to be done is to separate the amalgam from the vast amount of earthy matter with which it is associated, which is done as follows, in most of the well conducted works:—There are arranged in a shed—*lavadero* or washing-house—three large round tanks, built close together in a circle, and communicating with each other by means of an oblong opening about 13 inches high and 8½ inches wide, commencing at about a foot from the bottom, and terminating at about the same distance, or a little more, from the top. These tanks—tinas—are built of stone-slabs, which have to be very carefully cemented together, particularly those at the bottom, as much of the mercury might be lost. In the centre of each tank there is an upright shaft, carrying four cross arms, to which are attached long wooden teeth or stirrers, the whole being moved by one mule. The pinions which move the agitators of the second and third tank are a little larger than that attached to the first, so as to give them rather a slower motion. The tank into which the metallic mud is first thrown is called *la tina cargadora*—(the charging tank)—and the last one the *descargadora* or discharger. The torta, before being washed, is divided into a certain number of parts; each part, before being taken to the washing-house, being softened with water and a treading. A given portion—which is measured by large wooden bowls—of the lama is thrown into the first tank (*cargadora*), water being

allowed to run in and the machinery being made to revolve rapidly (the driving mule going at a gallop) at the time of charging, so as to break up and separate the whole mass as much as possible. Little by little the mule is made to go gradually slower and slower, till at last it only moves at a gentle walk: the mules being specially trained to the different paces required. From time to time the *azoguero* removes a portion of the slime under treatment, and washes it in a jicara:—from the amount of mercury remaining at the bottom—which at last ought to be a mere trace—it is judged when the water holding the earthy particles in suspension may be run off. This is done by opening a large plug near the bottom of the last tank—*descargadora*. When the whole has run off, the plug is again put in, and the operation continued in a similar manner until the whole torta has been washed.

Besides the fluid amalgam which remains at the bottom of the tina, there is also a quantity of the heavier portions of the ore—*cabezilla*—which is very rich in amalgam. This is removed in wooden bowls to a tank—*pila apuradora*—and thrown into a large bowl called a *batea apuradora*; these vary from three to five feet in diameter, and float on the surface of the water. The person who manages this batea leans over the side of the pila, and with a hand on each side of the batea manages to give it a peculiar shaking or rocking motion, at the same time constantly dipping up a small quantity of water, which he washes round the batea and then throws out, carrying with it a portion of the *cabezilla*.

This is repeated till there is collected from 20 to 30 lbs. of *pella*—amalgam—which is carried to the *azogueria* (mercury house), where it is deposited in a large stone trough. When the whole of the amalgam from a torta, or as much as the trough will conveniently hold, has been collected, a large quantity of pure mercury is added, and also a gallon or two of water. Two men next thrust their right arms into the amalgam and stir it about in every possible direction for some time, for the purpose of cleaning it as much as possible. Every now and again the matter which collects on the surface is removed, as is also the water, and the operation repeated time after time until the surface of the amalgam presents a bright smooth surface, when it is very carefully wiped with a woollen cloth.

Pressing Amalgam or Pella.—When the amalgam has been properly cleaned as above, it is removed into a cone-shaped *bag-manga*—made of sail-cloth with an outer covering of leather on the sides. This manga is hung from a beam, and the excess of mercury filters through the canvas bottom into a trough beneath it. The amalgam is allowed to remain in the bag, as a general rule, about two hours, when it is emptied out on to a table. It now presents the appearance of very fine sand; and in this state is next beaten into iron moulds, and formed into bricks—*bollos*—of about three or four inches thick, and wedge-shaped, so that when six of them are placed together they form a circle, leaving a round hole in the centre for mercurial vapours to pass through in the next operation.

Burning.—The final operation is to expel the last traces of mercury from the silver, which is done under a large copper bell. Below the floor of the burning house there is a tank, through which a stream of cold water is constantly flowing. In this a round tripod is placed,

on the top of which is laid a round iron plate, with a hole in the centre, about two inches in diameter. On the top of this is placed the bollos of silver, as high as the bell will admit, there being a space of about an inch left between the silver and the side of the bell. This is now lowered on to the top of the silver, the joints at the bottom being well secured. There is next put round the bell (leaving a space of about six or eight inches) mud bricks or *adobes*; the intermediate space being filled with charcoal. This is now ignited, and as the heat increases the mercury begins to pass off into a receptacle below. The fire is kept up for about 12 or 15 hours, when the whole is allowed to cool, and the bell removed. The silver is then found to have a beautiful honeycomb appearance, and is called *plata pina*. In this state it is removed in leather bags to the government melting and assay office to be run into bars.

It may be worthy of remark that silver produced by the patio amalgamation is purer than that produced by any other method. I have often seen it produced in Guanaxuato as fine as that specially prepared in London for check silver.

The duration of the amalgamation process is very various, and depends on many circumstances. About 25 days may be taken as the average time to work a torta.

Loss of Mercury.—There are two sources of loss of mercury in this operation. One is called the *consumido*, or the portion required to reduce the silver to the metallic state; in practice, weight for weight is allowed, the correct proportion being as 100 is to 108. Every thing lost beyond this is called "*perdida*." It may be taken as a general rule that from 10 to 16 ounces of mercury are sacrificed for each mark (8 ounces) of silver obtained.

Loss of Silver.—The loss of silver in this amalgamation process is considerable, and varies much according to the class of ores operated upon, and particularly on the quality of the grinding, on which depends very much the success of the operation. From 10 to 14 per cent. is an average loss on docile ores; much of this, however, is lost in the form of amalgam from being carried away in fine particles by the water used in washing the tortas; but if more perfect washing vats were employed I have no doubt but the loss of silver could be much decreased.

(*To be concluded in our next.*)

Faults, Dislocations, and Disturbances in Coal Mines.

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Dislocations of strata, and other disturbed conditions of coal beds, are so frequently met with in mining operations, and are so intimately associated with plans for colliery workings, that an acquaintance with their leading features is indispensable. All proposed plans for

"laying out" the underground works of mines are likely to be interfered with, and greatly modified by "faults;" and, indeed, the methods of working the coal, and the system of ventilating the mine, are in many cases adopted as being most suitable for the "*disturbed strata*," in which the coal seams occur.

The terms dislocation and displacement, when applied to these geological accidents, are easily understood by any one; but the technical names commonly used in mining districts seem to require some explanation, and more clearly-defined application than they at present possess. The name "fault" may be very appropriately applied to all kinds of alterations in the rocks, by which the position or form of the beds or lodes of mineral have been in any way changed from their original relative places or conditions; and may thus be used to include all alterations of mineral deposits from a good marketable quality to an inferior and useless description. The latter kind of changes, or where there is merely a slight interruption in the uniform character of a bed of coal, either as regards its quality or any very sudden change in the plane of its bed, is generally called by colliers a "trouble." The names "dyke," "slip," "hitch," "slide," "heave," "thing," "Vs," "nip," "want," "throw," "shift," "float," "check," "balk," &c., are all of them given to the different kinds of "faults" and "troubles" which are so frequently encountered in all kinds of mining, and most of them are only localisms, the miners in each large mining district having their own names for each particular kind of fault. When referring to instances of disturbance, illustrated by the wood-cuts, I shall show how these names are applied.

"Trap dykes," or what are sometimes called by miners "whin dykes," are masses of hard feldspathic or hornblendic rock—or sometimes a mixture of these two substances, and then called greenstone—which have been intruded between the planes of fracture, thereby preventing the dislocated beds from settling back into their former position. In some cases these trap intrusions may indeed increase the dislocation; and when we consider the very extensive up-heavals of trap, such, for instance, as are to be met with in various places in the coal field of Scotland, we have before us a most fertile source of dislocation, and other kinds of disturbance.

The unmistakeable effects of intense heat are found to be almost invariably associated with the dykes of trap as they are met with in coal and iron-stone mines. A familiar instance of this has long been known in the case of the 90 fathom or Cock-field-fell dyke of Northumberland, from 18 to 20 yards thick, where the coal, for 50 yards on each side, is said to be converted by heat to a condition differing widely from its original one. The first appearance of change in the coal when approaching this gigantic wall of trap is the disappearance of calcarous spar from the joints and backs, and the alteration in the lustre of the coal from a bright shining black to a dull sooty kind. The coal-bed becomes gradually less, until from six to eight feet—its ordinary thickness—it is reduced next the dyke to nine inches, the coal in this position being converted into "dawk" or "swad" (consolidated soot), while at a greater distance from the dyke it is changed into a hard cinder. The roof of the coal seam is said to be full of brasses (iron pyrites). In the

Scotch coal field, the coal of the whole colliery districts is altered by the same kind of agency, and ordinary black-band iron-stone is found to be completely calcined and rendered magnetic.*

A good example of a very large trap dyke, of from 250 to 300 yards in width, may be seen in the grounds of the Glasgow Necropolis. It has been penetrated to a considerable distance by quarrying for paving stones, and the structure of the trap—its frequent columnar feature—may be seen there to advantage.

Some large specimens of burnt coal, which have been supplied to me from the Newton pit, near Glasgow, by the kindness of Mr. James Smart, exhibit also a columnar structure of remarkable regularity; the columns being each about half-an-inch in diameter. This somewhat uncommon feature in the "altered coal" is doubtless owing to the same process as that by which columns of basalt are said to be formed—that is, the escape of heat from as many centres of cooling as there are columns of the material—this radiation of heat from the respective centres tending to produce, from an original globular mass, a cylindrical column; but a prism resulting from the resistance of each radiating force by the surrounding and counteracting forces.

Examples of trap dykes, and of various forms of interstratified trap, are so numerous in the Scotch coal field alone, that a minute description of the whole of those which have been met with in the coal and iron-stone mines, would be quite sufficient for a large volume on the subject. An interstratification of trap (felstone containing small threads of satin spar) has been passed through by a "drivage" under the superintendence of Mr. Stokes, measuring about 64 feet. The coal is hard and "brassy" on each side of this "tongue" of felstone, and exhibits such indications of having been once exposed to heat, as to lead the colliers to give it the name of "burnt coal." From the "Records of the Government School of Mines," it appears that sheets of green-stone have been similarly injected in the mining district of South Staffordshire, over an area of more than 20 square miles, varying from 15 to 60 feet in thickness. The coal which has been altered by these trap intrusions is called, by the Staffordshire colliers, "brassil"—a very appropriate name, when we remember that "brass" is a very old mining term for iron pyrites.

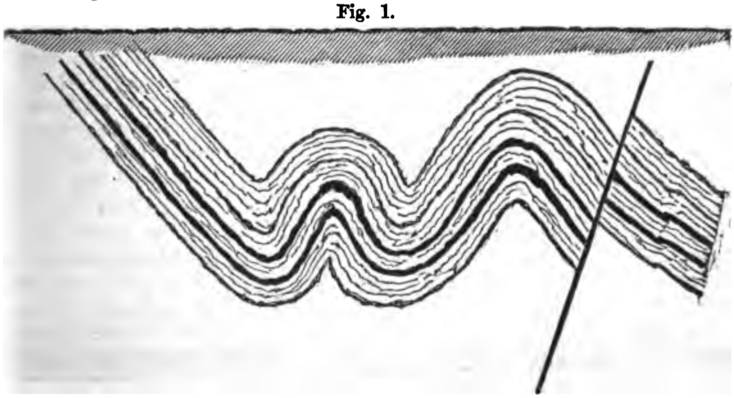
"Dyke" is a North British name for a stone wall, and as far back as the last year of the past century, we find a Welshman, who had been many years a mining engineer in Scotland, writing—"I suppose that this species of coal-trouble was first called *dyke*, from the resemblance of some of the lesser hard ones to a stone wall, or stone dyke, some of them being no thicker than a common garden wall; however, these dykes vary greatly in thickness as well as in quality, and the matter of which they are composed. They vary in thickness from two or three inches up to a great many fathoms: nay, in some instances, the thickness is too great to be pierced through with a "mine;" in which case the miner is obliged to abandon the present pits, and to search for the coal upon the other side."

* I am indebted to Mr. Arch. Grey, of Dalry, for specimens of "burnt ore" from a trap dyke in one of Messrs. Merrie and Cunningham's pits.

The sheets or interstratified "flows" of trap can be easily distinguished from the dyke of trap, as the former present a very irregular line of junction with the coal, and are bounded by the planes of the roof and floor of the coal seam, like the coal itself; while the latter present a more regular face to the coal, and intersect the plane of the floor, passing downwards to unknown depths, and in the majority of cases also passing upward through the roof to the surface, or at least to the top of the coal-measures.

When a "slip" or a "dyke," is arrived at by an exploring drift in a mine, the important question to be solved, is the direction in which the displacement of the strata has taken place. An old and very safe practice in determining this, is to depend upon an acquaintance with the strata. For example, if in working a coal seam and passing through a slip fault any stratum should be recognised as being indentical with what was known to be 108 feet above, it would be sufficiently reliable evidence that the coal seam would be found the same distance below, and *vice versa*. There is, however, an almost invariable "law of faults" by which a solution of this problem may be determined irrespective of this practice; indeed depending on a recognition of the strata after passing through the "Vs," or planes of a fault, is very liable to failure, as the recognition may not be a certain one, or the strata may be so entirely new to the observer that recognition is impossible. The "law of faults" may be stated as follows:—If the plane of the coal bed makes an obtuse angle upwards with the plane of dislocation, the fault will be an "upthrow." If this angle be acute, the fault will be a "down-throw." In the case of very highly inclined beds of coal or of mineral lodes, this law may be stated thus:—If the angle contained between the left-hand wall and the face of the fault be obtuse, it will be a "right-hand" heave; if this angle be acute, it will be a "left-hand" heave. The following more simple and "practical" language expresses the same law:—In the case of coal beds,—if the coal is lost in the "sole" or "pavement" first, the fault will be an up-throw; if in the roof first, it will be a down-throw. In highly-inclined coal seams, or in mineral lodes,—if the mineral is lost first on the right-hand wall, the fault will be a heave to the left; if the mineral be first lost on the left-hand wall, the fault will be a heave to the right.

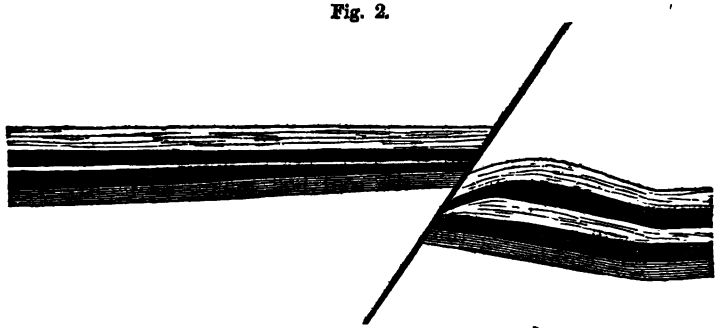
Fig. 1.



The dislocation, illustrated by Fig. 1, of a fault which seems to have been met with since I examined these contorted coal beds in a coal mine at Warmley a few years ago—appears to furnish an exception to the "law of faults" referred to. I am indebted to Mr. Stewart, of Bristol, for the particulars of this displacement, and if in this case there really is an exception to the general law, as is shown by the sketch, it may doubtless be accounted for by the peculiar agency through which the fault has been produced.

The amount of displacement of beds by either a "slip" or "dyke" fault, or what is known by miners and geologists as "the throw of the fault," varies from a few inches to 1000 yards. A "hitch" is where the "throw" does not exceed the thickness of the coal seam. Figure 2, is an instance which has been supplied to me from measurements by Mr. Carey, of two coal beds being brought very nearly on the same plane with each other by a slip fault, while under ordinary circumstances they are 15 or 16 fathoms apart. The *rough main*

Fig. 2.



Rough Main Seam. Splint Main Seam.

coal shown here averages about three feet in thickness, and is separated in the middle by four inches of shale. The *splint main* coal is from five to six feet thick, and has a shale parting in the middle of about two feet in thickness. This seam has evidently been raised up through the greater part, if not through the whole, of the amount of throw: the effect of the upward thrust is seen on the bend of the seam at A, and on the ends of the coal, and the associated strata, being turned downwards towards the Vs or plane of fracture. The thinning out of the *rough main* seam towards the slip is remarkable in this case, although, in connection with faults where the fissure has been filled up with trap, this alteration in a coal bed seems to be no uncommon occurrence. In both cases it is doubtless owing to the escape of a large portion of the coal under the condition of a gas, during the period of displacement, caused, in the one case, by the heat of the molten trap combined with that arising from friction, and, in the other, by the heat from friction alone. From a consideration of the way in which the forces have operated to produce the phenomena observable in this slip fault, it is easily seen that the pressure upon the *splint main* coal, and the effect of rubbing against the broken ends of the opposite strata, would be such as to prevent the escape of gas from the seam, even supposing that there might be access to it for atmospheric air to

admit of the decomposition of the coal; while, on the other hand, the effect upon the *rough main* seam would just be such as to facilitate the rapid decomposition of the coal, and the liberation of the gaseous products. The thining of the bed, and a perceptible alteration in the character of the coal, is observable in this case through a distance of 60 feet.

(To be concluded in our next.)

Abstracts and Reviews.

OBSERVATIONS ON SILICA.—By Arthur H. Church, B.A.

(From the Journal of the Chemical Society.)

The recent researches of Mr. Graham in dialysis have shown us how to prepare a pure aqueous solution of silica of considerable strength and with great ease. Pure water, according to Kirwan, is capable of taking up no more than one-thousandth part of its weight of hydrate of silica freshly precipitated, while there it no difficulty in obtaining, by the dialytic method, a liquid containing fourteen per cent. of that substance. The other processes for procuring silica in solution are less satisfactory, for it is difficult to free the product from hydrosulphuric acid when sulphide of silicon is used; and on heating gelatinous silica with water in a glass tube under pressure, the glass is acted on, and a portion of alkaline silicate formed.

A solution of silica containing more than 0.5 per cent. of the anhydride cannot be kept long without change; but I have observed no alteration as to transparency or fluidity in a solution containing 0·47 per cent. after the lapse of three months. With respect to stronger solutions, the process of gelatinization is generally more or less gradual. Freshly prepared, a solution containing 3 per cent. of anhydrous silica was perfectly limpid, and nearly as mobile as water; after the lapse of six days it acquired the consistence of glycerin, and then rapidly became ropy, the silica separating in gelatinous masses. The solution in this case was kept in a well-stoppered bottle. Solutions of silica obtained by dialysing an alkaline silicate after addition of hydrochloric acid, seem, according to my experiments, to retain their fluidity longer than those of the same strength where sulphuric acid has been used; and as a general rule, the purer the solution and the freer from acids and salts, the longer may it be preserved without change.

The cholrides of barium, strontium, and calcium, and many other salts, produce no immediate precipitate in an aqueous solution of silica; but solutions of the alkaline earths at once throw down the whole of the dissolved substance; or, if they be added in insufficient quantity, the silicate formed causes the remainder of the silica to separate as a jelly. This action is still more prompt if the carbonates of calcium, strontium, or barium be made to react upon the silica solution. One milligramme of pure carbonate of calcium in fine powder was put at the bottom of a beker, and then 100 cubic centimetres of a 1 per cent. silica solution were poured upon it; in ten minutes, the mixture was a firm jelly, and the vessel could be inverted without the loss of any of its contents.

I cannot but think that this singular deportment of the aqueous solution of silica with the carbonates of the alkaline earths tends to throw great light upon several important geological and mineralogical questions. Silica, we know, is almost an invariable constituent of the waters of the earth, and in several cases it exists in solution in considerable quantity, rather as silicic acid

than as an alkaline silicate. Several springs in Iceland, at Luzon, in the Philippine Islands, and in New Zealand, deposit a beautiful quartz-sinter, containing scarcely more sodium and potassium than common flint. But the action of far weaker solutions of silica may, I believe, be traced very frequently in less striking but more common conditions. I have endeavoured to test this supposition by a series of experiments, an example of which I will now describe.

A curious silicified substance, at once a mineral and a fossil, occurs in the triassic red conglomerate of Torbay and its neighbourhood; similar, if not identical, bodies are found in other parts of great Britain, and also in a few foreign localities. This mineralized fossil, to which the name of "Beekite" has been assigned, presents itself under such a variety of aspects as to baffle description, so far as regards its physical features; its chemical composition is more constant. Originally corals or shells, and therefore, consisting in great measure, of carbonate of calcium, beekites have become so modified in constitution as to contain on an average, no less than 92 per cent. of silica; a small but variable amount of calcium occurs in them, but this exists as silicate rather than carbonate; a few exceptional cases have been noted, where the process of silicification has been arrested before completion, and where the interior of the beekite may be completely dissolved away by hydrochloric acid, though the outside is not affected by this reagent. I have attempted to transform corals and shells into a substance resembling that of which beekites consist. The trial is made in this wise. A fragment of recent coral was fitted tightly into the neck of a funnel, and a solution of silica in water containing dissolved air and carbonic acid was allowed to fall upon it drop by drop. The liquid which filtered through contained much carbonate of calcium, but no silica, while the coral ultimately retained very little carbonate of calcium. The silica solution should be very dilute, about 0·15 per cent., otherwise part of the silica will gelatinize on the surface of the coral and prevent further action.

I have endeavoured also, to illustrate, by means of the aqueous solution of silica, that tendency to deposition, in a circular or globular form, which is so marked a characteristic of many siliceous minerals, such as quartz-sinter, eyed agate, bubble-chalcedony, and especially beekite. In the latter case, the surface of the specimen generally shows a number of tubercles surrounded by systems of concentric ridges. So strongly is this circular tendency developed in some instances, that a fragment of a silicified pecten, in my possession, shows a system of rings, partly situated in a furrow of the outer aspect of the shell, then bent upwards to follow the natural curve of a ridge, and then turned down into another furrow. I was anxious to see whether such circular forms could be attained artificially, and the more so as Mr. Rainey has obtained similar globular crystals of carbonate of calcium. Although I have not at present arrived at any definite conclusion on the subject, I have yet observed, in working with an aqueous solution of silica, several phenomena which may suggest an answer to the question. Among these phenomena the following may be mentioned: the irregular spherical masses into which a solution of silica often dries up in the air, the faint curved markings developed in a piece of oyster-shell after artificial silicification, and the singular narrow flakes into which the film of silica, forming round and just above the margin of aqueous solution, when evaporating in a dish or beaker, divides. These narrow strips curl inwards, the ends meet, and the rings or sections of cylinders thus formed accumulate in the liquid, presenting an appearance of great interest, the origin of which was not at first sight apparent.

PREPARATION OF BRASS.

(From Dr. Percy's "Metallurgy.")

Until a comparatively recent period, all brass was made by the odd process of *cementation*, which has been almost entirely superseded by that of alloying zinc in the *metallic* state directly with copper. This ancient process, which has been practised for centuries, was, nevertheless, patented in this country in 1779, by Mr. John Champion, senior! *

Manufacture of Calamine Brass.

Only a few years ago, I saw the old process carried on in Birmingham, at Mr. Pemberton's works, the last which survived in that town; but they have since been pulled down, and I am not aware whether a single calamine brass furnace is now in operation in England. In 1859, I found several of these furnaces still in existence at the copper-works of Messrs. Sims, Nevill and Company, Llanelly, Glamorganshire, and there are others, I am informed, at Swansea. I am indebted to the kindness of the firm just mentioned for permission to examine them, and take the measurements. I have also pleasure in stating that I received much of the following information concerning the mode of conducting the process, from the late Mr. Joseph Stringer, who had been during a long period in their employ, and who had superintended the furnaces.

Description of the Furnace.—It exactly resembles, in all essential points, the furnaces represented in the engravings contained in old metallurgical treatises. It consists of a circular chamber, lined with firebrick; it is contracted above to a circular opening, the mouth, in which is fixed a cast-iron collar; it is closed at the bottom by a circular cast-iron plate or bed-plate, in which are 12 holes symmetrically arranged round one larger hole in the centre, through which the ashes and clinkers may be withdrawn from time to time; below the bed-plate is the ash-pit, communicating in front by means of an arched air-way, with a long arched passage or vault, through which air is conveyed to the furnace from the outside, and the workmen obtain access to the ash-pit. Over the small holes in the bed-plate are placed short nozzles or twyers of cast-iron, tapering upwards, the larger central hole being left without a nozzle. The nozzles are 6 inches high, 2½ inches in diameter at the bottom, and 1 inch at the top, inside measure, and three-quarters of an inch in thickness. The space between the nozzles is filled up level with bricks and fireclay, so as to form a solid bed 6 inches thick. The air which sustains combustion enters through these nozzles, which are used as a substitute for bars. The furnace is enclosed in a solid mass of brickwork; and for the sake of strength, at the back of the arch over the air-way, and in front of the bed-plate, is placed an iron bar resting upon the walls, which form the sides of this air-way. Several of these furnaces are constructed in a row, and over the whole is built a room of brick covered in with a large brick cone open at the top, exactly like an ordinary glass-house. It will be perceived that the furnace has no chimney, except the mouth, which is kept more or less closed, according to circumstances, by a circular cover of cast-iron, or of fire-brick set in an iron frame.

* A.D. 1779, November 24, No. 1239. Abridgments—Metals and Alloys, p. 22.

Crucibles.—The crucibles employed are made of fire-clay. They are circular, and 12½ inches deep, 8¼ inches wide at the top, and 6¾ inches in the middle, inside measure; they are 1 inch thick at the top, and 2 inches thick at the bottom. Mr. Stringer informed me that he was always accustomed to employ a slightly larger crucible, which is termed the *king-pot*, in the centre of the bed-plate; but another calamine brass maker, of great experience, tells me that there is no necessity for this variation in the size of the crucibles. According to Mr. Stringer, the *king-pot* should be 13½ inches deep, 8½ inches wide at the top, and 7¾ inches wide in the middle; 1¼ inch thick at the top, and 2 inches thick at the bottom. Such a crucible will hold 120 lbs. of metal, while one of the smaller size will only hold 84 lbs.

Composition of the Charge.—Calcined calamine or blende calcined *sweet* and ground fine, 100 lbs., ground coal, 40 lbs. These are intimately mixed *dry*, and passed through a sieve of 8 holes to the linear inch. The mixture is then spread level, and 2 gallons of water are poured upon it; after standing half an hour, it is again well mixed and passed through a sieve of 4 holes to the linear inch, after which it is levelled and thoroughly mixed with 66 lbs. of *bean-shot* copper. The mixture should be sufficiently moist to adhere together by pressure with the hand. It is now ready for charging, and produces brass for the *best battery* purposes, *i.e.* brass intended for hammering, &c.

Mode of Charging.—It is supposed that the furnace has become previously heated in the regular course of working. The pots are charged with care, moderately lightly, and covered; the central hole in the bed-plate having been previously stopped with clay. Four flat pieces of coal, each about 15 inches long, from 3 to 4 inches thick, and 8 or 9 inches wide, are placed so as to form a cross over the pots, one end of each piece resting on a side-pot and the other on the king-pot. 3 cwt. of coal broken in pieces a little larger than the fist are then carefully put into the furnace, the fall of the coal being broken by placing a pair of tongs in the mouth, which is afterwards partially closed. The coal is thus left to burn until "all the gas is out of it," which will require about 1½ hour, when the cover is placed over the mouth to within half an inch on one side in order "to harden the coke" formed. After this, the coked coal is cautiously poked down amongst the pots, care being taken to keep the draught holes open and clear. The cover is now placed to within 1½ inch on one side of the mouth, and the furnace may then be left during 3 hours without a further supply of coal. It is the duty of the foreman to see that the draught holes are properly cleared and the pots kept covered with coke. The heat is gradually raised in the course of the process by removing the cover a little on one side. The process, if properly attended to, will be completed in about 10 hours.

The brass which has been formed is now to be collected. The king-pot is taken out and its contents are well stirred with an iron bar having a flat or paddle-end. One of the side-pots is next taken out and treated in the same manner, when the brass, which has subsided to the bottom, is poured into the king-pot. The other side-pots are taken out in succession, and the same process repeated with

each. The king-pot is well shaken with the stirring-bar during the pouring. The brass from all the side-pots having been thus collected in the king-pot, the metal in the latter is skimmed and poured into iron ingot moulds. It is scarcely necessary to remark, that as soon as a side-pot has been deprived of its brass, it should be replaced while hot in the furnace. An old calamine brass-maker informs me that good pots lasted on an average 16 days, not being allowed to cool during that period.

It is important in the manufacture of calamine brass, that the king or receiving pot should always be the cleanest, and have as little matter adhering to its sides as possible. The paddle is pushed down round the sides, so as to get the metal together, which cannot well be done if there is much concretionary matter round the inside; and by gently bumping the bottoms of the pots on the floor, the subsidence of the metal is promoted.

The following details relate to Mr. Pemberton's calamine-brass-works formerly in operation at Birmingham. The diameter of a furnace was 3 feet 6 inches at the bottom, and the height 3 feet 6 inches to the collar. Stourbridge clay crucibles employed, 12 inches deep and 8¼ inches in diameter. Each furnace contained 9 such crucibles. In later times only two qualities of brass were made, which were distinguished by the marks B.I. and B.XX. The charges were as follows:—

	B. I.	B. XX.
	lbs.	lbs.
Feathered-shot copper	64	61
Ground and sifted calcined calamine from Somersetshire	88	97
	bushel.	bushel.
Coal-slack	1	1

Cost of Making Calamine-brass in the last Century.—The following details, extracted from Mr. Morris's Journals previously referred to, may now be interesting to brass-makers for the sake of comparison:

BRASS HOUSE CALCULATION IN 1781 (AT THE FOREST WORKS.)

Dr. cwt. qrs. lbs.	£	s.	d.	Cr. cwt. qrs. lbs.	£	s.	d.
9 1 20 Copper shot at £86 per ton	40	10	10	By 14 0 16 Brass at £90 per ton	68	12	10
14 0 16 Calamine at £6 per ton	4	4	10	10 lbs. of do. in skimmings at £45 per ton	0	4	0
2½ bags of charcoal-dust at 30s. per dozen	0	6	3		£63	16	6
33 bags of coal at 35s. per wey	0	15	4				
John Spears' week's wages	0	15	0				
His brother do.	0	12	0				
Helper	0	6	0				
Wear of furnaces, tools, grinding and dressing calamine, charcoal, fern, &c.	0	7	6				
	47	17	9				
If copper at £96 per ton, add	4	14	3				
	52	12	0				
If the brass is made richer by using 6 lbs. more copper every charge	5	14	4				
	£58	6	4				

The copper is estimated to increase 50 per cent. in weight; and the brass, which is composed of two parts of copper and one of zinc, to be equal to the weight of the calamine used.

THE BRASS HOUSE CALCULATIONS IN 1784.

Dr. cwt. qrs. lbs.	£	s.	d.	Cr. cwt. qrs. lbs.	£	s.	d.
14 2 26 Copper shot at £80 per ton..............	58	18	7	By 22 0 11 Brass at 65s. per cwt......................	71	16	4
22 0 11 Calamine at £5 15s. per ton	6	7	1				
12 bags of charcoal at 30s. per dozen	1	10	0				
¾ wey of coal at 35s. per wey	1	6	3				
Workmen's wages	1	4	0				
Wear of furnaces, tools, grinding and dressing calamine, fern, &c.............	1	3	0				
	70	8	11				
Profit..............	1	7	5				
The furnaces in one week	£71	16	4				

In this process oxide of zinc is reduced at a temperature below the melting-point of copper, which, being thus exposed to the action of the vapour of zinc, becomes permeated with this metal and converted into brass. Care must be taken so to regulate the temperature that the *copper shall not melt*, but remain diffused through the mass of the charge; for if it were allowed to melt, it would trickle down to the bottom of the pot, in a greater or less degree, and much of the zinc would then escape.

By exposure to the vapour of zinc, copper may be converted into brass even below the melting-point of this alloy. In illustration of this fact, the following pretty experiment may readily be made:—A little zinc is placed at the bottom of a clay crucible, and covered with a layer of coarsely-pounded fire-brick or burnt fire-clay; a copper coin is then introduced and surrounded with coarse charcoal-powder; after which the crucible is closed with a luted cover, and exposed during a considerable time to a gentle red-heat. The surface of the coin will by this means be converted into yellow brass, without obliterating the effigy and other characters upon it. In experiments of this kind which we have made, the surface has always had a crystalline or *frosted* appearance.

Calamine-brass was formerly used by button-makers in the manufacture of *gilt buttons*, which were gilt by the old process of *water-gilding*, *i.e.* by means of mercury (*lucus a non*, &c.)—a designation which would be more appropriate to the modern method of electro-plating. It was preferred for this purpose, because it was said to receive the gold better than brass made from spelter; and to "stand the soldering better," to which these buttons were subjected in attaching the shanks. It was also specially used in making the wire-gauze employed in the sieves of papermakers. A thoroughly practised brass-worker in Birmingham most positively maintains to me that he can immediately distinguish calamine-brass from common brass

by the peculiar appearance of its polished surface. Why calamine-brass should differ from common brass, I do not at present understand; but that such difference actually existed when the former kind of brass was largely produced, can hardly be denied. Indeed so impressed are some of the Birmingham brass-founders with the fact of this difference, that quite recently I know one large firm has applied to an establishment in Glamorganshire for calamine-brass. Perhaps the difference between the two kinds of brass would not now be found, if the manufacture of calamine-brass were resumed; and that which formerly existed may have depended upon inferiority in the quality of the zinc produced at that time. Calamine-brass, I believe, ceased to be manufactured in Birmingham because its price was sensibly higher than that of common brass.

I have met with a statement to the effect that a Mr. Champion obtained a patent, about the year 1818, for making brass by exposing plates of copper to the vapour of zinc *below* the melting-point of brass;* but in the Abridgments of Specifications relating to Metals and Alloys, I do not find any record of this patent. It has been supposed that the remarkably malleable brass of Nuremberg was produced by a similar method.

Direct Preparation of Brass.

This is effected either in *crucibles*, as in ordinary brass-foundries, or in *reverberatory furnaces*, as in the manufacture of yellow-metal sheathing. The crucibles employed for this purpose have been previously described. The zinc is gradually and cautiously added to the copper when the latter has *just* melted. The ingots of copper before being put into crucibles, should be heated to redness. The furnaces in use in Birmingham are about 10 inches square and two feet deep, while those which I have seen in London are round. The flue leading to the stack should be *small*, and close to the top of the furnace; but its size must obviously vary with the stack and other conditions. The fuel should be *good* coke, and not such as frequently contains a large quantity of corrosive ash. The metal, when well melted, is skimmed and poured into sand-moulds for castings of various kinds; or, when intended for rolling, into closed iron ingot-moulds, previously warmed, lightly oiled and dusted over with charcoal in the interior. In former times moulds of granite were used for casting ingot-brass. In the making, casting, and remelting of brass, there is always an inevitable loss from the volatilization of zinc, for which a due allowance is made to the founders when they deliver the metal.

The Chinese appear to be unacquainted with the art of rolling brass, and, as substitute, cast it into tolerably thin sheets. I have a specimen of one of these, rather exceeding 1-16th of an inch in thickness, which I received from my friend Harry S. Parkes, so well known in his official capacity in China. It has been analysed in my laboratory by Mr. T. Philipps, and found to have the following composition:—

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* Manuels-Roret Alliages Métalliques, Paris, 1839, p. 169.

Copper	56.59
Zinc	38.27
Lead	3.30
Tin	1.08
Iron	1.47
	100.71

Muntz's Metal.—This alloy, and its application "for sheathing the bottoms of ships and other such vessels," was the subject of a patent granted to the late George Frederick Muntz, of Birmingham, in 1832.* The proportions specially recommended in the specification are 60 per cent. of copper, and 40 of zinc; but these proportions may be varied from 50 up to 63 per cent. of copper, and from 50 down to 37 per cent. of zinc. Best selected copper and foreign zinc are directed to be used. The metal is cast into ingots and rolled *while hot* into sheets, which, when finished, are "pickled" in sulphuric acid diluted with water to free them from adherent scale, and afterwards washed in water. In the same year Mr. Muntz obtained a second patent for "an improved manufacture of bolts and other the like ships' fastenings."† Precisely the same proportions of copper and zinc are claimed in this patent as in the first. In 1846 a third patent was granted to Mr. Muntz for the use of an alloy consisting of 56 per cent. of copper, 43¼ of zinc, and 3¾ of lead.‡ In the specification it is directed that only the purest metals should be used, and that the alloy is to be cast into ingots, which are to be rolled at a red heat, and treated in other respects in the manner stated in the specification of the first patent. I am not aware whether the alloy last described has ever been manufactured and applied; but my impression is that it has not; and I shall, therefore, dismiss it from further consideration. I may state that I have succeeded in rolling brass well, which, on subsequent analysis, was found to contain not less than 8 per cent. of lead.

The theory assigned by Mr. Muntz for the application of his alloy is, that by exposure to sea-water the zinc is slowly and uniformly corroded over the entire surface, whereby the attachment of barnacles, &c., is prevented. Mr. Faraday informed me that in a specimen of sheathing formed of the alloy in question, which had long been exposed to the action of sea-water, he found no zinc remaining. Experience, especially of late, has certainly not confirmed the statement concerning *uniformity* of corrosive action, as much of the modern sheathing is eaten away in holes, notwithstanding the declaration of copper smelters that in the manufacture of yellow metal they employed only *best-selected* copper and zinc of the best quality!

Muntz's metal, or yellow-metal sheathing, has entirely superseded copper-sheathing in the merchant service, though the latter is still retained in the Navy. Its special advantages are stated to be, that it keeps the bottoms of ships cleaner and costs considerably less than copper-sheathing.

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* A.D. 1832, October 22. No. 6325. Abridgments of Specifications relating to Metals and Alloys.

† A.D. 1832, December 17. No. 6347.

‡ A.D. 1846, October 15. No. 11,410.

It is now generally made in reverberatory furnaces, the zinc being cautiously added to the melted copper. The melted metal is tapped into a vessel lined with clay, out of which it is laded into suitable closed iron ingot-moulds, the interior of which has been lightly oiled and dusted over with charcoal in the usual manner. Just previously to tapping, samples of the alloy are taken out, in the same manner as copper-proofs in the process of refining copper, and cast into small ingots, which are passed through rolls while still hot, and are afterwards broken across, when, if the fracture presents the proper appearance, the metal is tapped out forthwith. The fracture should be close and finely granular; but if it does not present the proper appearance, zinc is thrown into the furnace and well mixed with the alloy, after which the fracture is again examined, and if it is right, lading takes place immediately; but if not, the process of adding zinc and the testing of the fracture must be repeated until the desired quality is attained. The eye of the furnace man requires to be educated for this kind of examination. Although the proper quantities of the two metals may have been put into the furnace in the first instance, yet, from the very nature of a reverberatory furnace, it is impossible to calculate upon the precise amount of zinc which may be volatilized, even in the same furnace at different periods. Hence the necessity of testing, &c., above described. But as the usual charge of a furnace consists of copper, "new scrap," and old yellow sheathing, of which the average composition is not exactly known, it becomes all the more necessary to follow the course above described in order to produce an alloy of the right quality. I am informed by an experienced yellow metal manufacturer, that the proportion of zinc should not exceed 38 per cent.—that if it sensibly exceeds this proportion, the sheathing is apt to become friable—and that if it is sensibly below this proportion, it wears away too rapidly.

The rolled sheets, after final annealing, are immersed in dilute sulphuric acid, scoured on the surface with flannel and sand, and afterwards washed and dried.

I am assured that cast yellow metal nails of the same composition as the sheathing cannot be used for attaching it to the bottom of ships. The copper sheathing in the Navy is attached by nails having the following composition:—

Copper	86.82
Tin	9.30
Zinc	3.88
	100.00

Mr. Muntz, like most successful patentees, had to encounter opposition on the part of certain copper-smelters, and to defend his patent-rights in the Courts of Law. He succeeded in obtaining a signal victory over his opponents, which certainly has not always been the fortune of patentees who have benefited either themselves or the world by their inventions. At the expiration of the patent in the ordinary course of fourteen years, Mr. Muntz applied to the Privy Council for an extension of it, when he admitted, if I remember correctly, that it had yielded him a profit of not less than £68,000. The application was refused. A

few years afterwards, Mr. Muntz died, and his property was sworn under £600,000; The manufacture of the alloy is still conducted on a very large scale near Birmingham, by one or more of his sons. There are but few if any metallurgical patents which have been so profitable to the patentee as that of Mr. Muntz. Most of the large copper-smelters are now engaged in the manufacture of Muntz's metal.

GEOLOGICAL SOCIETY OF LONDON.

At the Meeting of February 26.—Prof. Ramsay, President, in the Chair.

George Charlton, Esq., Mining Engineer, Dukinfield, Manchester, and Julius Schvarcz, Ph.D., Stuhlweissenburg, Hungary, were elected Fellows.

The following communications were read:—

1.—"On the Drift containing Arctic Shells in the neighbourhood of Wolverhampton." By the Rev. W. Lister, F.G.S.

2.—"On a Split Boulder in Little Cumbra, Western Isles." By James Smith, Esq., F.R.S., F.G.S.

The Islands of Great and Little Cumbra have (like the west coast of Scotland) a cliff and terrace, indicating an elevation of about 40 feet above the present level of the sea, and the removal of at least 100 feet of rock (sandstone and trap); the sea at its present level having worn away the rock to the extent of only a small fraction of an inch. The terrace on the Little Cumbra has been moreover ground down and scratched by ice-action, the striæ passing unobliterated under the present sea; and on the terrace lies a split boulder, such as are known to fall from glaciers, and which the author thinks must also in this case have fallen from an escarpment of ice.

3.—"On the Ice-worn Rocks of Scotland." By T. F. Jamieson, F.G.S.

The author, first referring to the eroded surface of the rocks beneath the Drift-bed in Scotland, proceeded to show that the action of ice, and not that of torrents, could produce such markings, as he had observed in the bed of a mountain-stream in Argyllshire, down which had poured the torrent caused by the bursting of the reservoirs of the Crinan Canal. He then advanced reasons for considering that the erosion of the rocks in Scotland was due chiefly to land-ice and not to water-borne ice, bringing forward remarkable instances of ice-action on the glens and on the hill-sides at Loch Treig and Glen Spean, where moraines, blocs perches, striæ, roches moutonnees, and boulders lifted above the parent-rocks indicate a northern direction for the great ice-stream from Loch Treig to the Spean, and then an eastern course on one hand up Loch Laggan, and a western, on the other, down the Spean. Up Glen Roy, the ice had apparently passed north-eastwardly, over the watershed, towards the Spey. In Knapdale, Argyllshire, similar evidence is obtained of a great ice-stream passing over hill and dale; here falling into the Sound of Jura. The author referred to Rink's and Sutherland's observations on the continental ice of Greenland as affording a probable solution of these phenomena; and, objecting to the hypothesis either of floating ice and of debacles being sufficient to account for the conditions observed, he thought that land-ice, moving from central plateaux downwards and outwards, has effected the extensive erosions referred to, both in Scotland and other northern regions, at a time when the land was at a much higher level than at present. This must have been followed by a deep submergence, to account for the stratified and shell-bearing drift-beds.

At the Meeting of March 5, 1862.—Prof. A. C. Ramsay, President, in the Chair. George Ford Copeland, Esq., M.R.C.S., 5 Bay's Hill Villas, Cheltenham; William James Dunsford, Esq., 14 Taviton Street, Gordon Square; Charles Henry Gatty, Esq., F.L.S., Felbridge Park, East Grinstead, Sussex; and A. H. Green, Esq., M.A., Fellow of Caius College, Cambridge, were elected Fellows.

Sir P. G. Egerton, Vice-President, having taken the Chair, the following communication was read:—

"On the Glacial Origin of certain Lakes in Switzerland, Scotland, Sweden, and North America." By A. C. Ramsay, F.R.S., President of the Geological Society.

The author first stated that in this memoir he proposed to extend his theory of the glacial origin of the smaller mountain-lakes of Wales and Switzerland (published in "The Old Glaciers of North Wales") to those greater lakes of Switzerland, which, like the tarns above alluded to, lie in true *rock-basins*. He then explained a map, compiled from those of Charpentier, Morlot, and Mortillet, showing the ancient extension of the great Alpine glaciers across the Lowlands of Switzerland to the Jura, also over the area that surrounds the Lake of Constance, and on the South into the plains of Piedmont and Lombardy. All the great lakes of Switzerland, and the lakes of Como, Lugano, and Maggiore, lie directly in the course of one or other of these great glaciers; and, as shown by the soundings, and the levels of the rocks at their mouths or in the river-beds below, each of these lakes, like the smaller tarns of the Todten See and the lake at the Grimsel, was shown to lie in a true rock-basin. He then considered the question of the denudation of the Alpine and Miocene areas of Switzerland, and showed that none of the lakes lie in *aboriginal undenuded synclinal hollows*. Next that they do not lie in areas of mere watery erosion. Neither running water nor the still water of lakes can scoop large hollow basins like those of the lakes, bounded on all sides by rocks. Running water may fill them up but cannot excavate them. He next contended that they do not lie in lines of gaping fracture. A glance shows this with respect to such lakes as those of Geneva, Neuchatel, and Constance; and, reasoning on the nature of the contortion of the strata of the Alps, he contended that, though fractures of the rocks must be common, they need not be gaping fractures. To produce such a mountain-chain, the strata are not *upheaved and stretched* so as to produce open cracks; on the contrary they are *compressed laterally and crumpled up* into smaller space, and the uppermost strata, that pressed heavily on the crumpled rocks now visible, would prevent the formation of wide open fractures below; these upper strata, as in North Wales, having, over a great part of the area, been mostly or altogether removed by denudation. Next, lakes of the rock-basin kind do not lie each in an area of special subsidence. If so, for instance, we should require one for the Todten See, one for the Grimsel, one for the ancient lake of the Kirchet, several at the foot of the Siedelhorn, many hundreds close together in Sutherlandshire, and thousands in North America.

If, then, the lake-basins were formed by none of the above-named causes, the only other agent that has affected the country on a great scale is glacier ice. All the lakes lie directly in the courses of the ancient glaciers. The basin of the Lake of Geneva is 950 French feet deep near its eastern end, and was scooped out by the great glacier of the Rhone, the ice of which, from data supplied by Charpentier, was, as it issued from the valley, 3550 feet thick to the bottom of the lake. This great weight of ice ground out the hollow of the lake, which gradually shallows towards Geneva, where the glacier thinned and the grinding power was lessened. Where the same glacier abutted on the Jura, the ice-current was arrested, and it flowed to the N.E. and S.W.; and where the ice was thickest and heaviest above the Lake of Neuchatel, it ground out the hollow in which the lake lies.

The lakes of Thun and Brienz lie in the course of the great Aar glacier, those of Zug and the Four Cantons in that of Altorf; the Lake of Zurich lies in that of the Linth, the Lake of Constance in the course of the prodigious glacier of the Rhine Valleys, the numerous little rock-basin lakes near Ivrea in the line of the glacier of the Val d'Aosta, and those of Maggiore, Lugano, and Como in the courses of the two gigantic glacier-areas that drained the mountains between Monte Rosa and the Sondrio.

The sizes of the lakes and their depths were then shown to be, in several cases, proportional to the magnitude of the glaciers that ground out the basins in which they lie, and the circumstance as to whether the pressure of ice was broadly diffused, or vertical as in narrow valleys.

Finally, it was shown that rock-basins holding lakes are always exceedingly numerous in and characteristic of *all countries that have been extensively glaciated.* Lakes are comparatively few in the southern half of North America, but immediately south and north of the great lakes and the St. Lawrence, the whole country is *moutonnée* and striated, and is also covered with a prodigious number of rock-basins holding water. The same is the case in the North of Scotland, the whole area of which has been *moulded by ice;* and east of the Scandinavian chain, in another intensely glaciated region, the country is covered by innumerable lakes.

MEMOIRS OF THE GEOLOGICAL SURVEY.

The Geology of the Neighbourhood of Edinburgh. By H. H. Howell, F.G.S., and Archibald Geikie, F.R.S.E., F.G.S. — Appendix and Lists of Fossils by J. W. Salter, F.G.S.—London: Longmans.

The Geology of Parts of Berkshire and Hampshire. By Henry W. Bristow, F.G.S., Geologist, and William Whitaker, B.A., F.G.S., Assistant Geologist.—List of Fossils by Robert Etheridge, F.R.S.E., F.G.S.—London: Longmans.

The first of these Memoirs—Geology of the Neighbourhood of Edinburgh —is one of the most valuable that has yet been issued by the Survey. It comprises the district lying on either of the sides of the Pentland Hills, including measures ranging from the Lower Silurian to Upper Carboniferous, largely penetrated by eruptive rocks—a country presenting an extraordinary amount of interest within a comparatively narrow compass.

The country on the east side of the hills is a broad plain, consisting entirely of Carboniferous strata, extending southward until they abut against the Lower Silurians of the Moorfoot and Peeblesshire hills. These form a synclinal trough, in the centre of which is the Mid Lothian basin of coal-bearing strata, the probable equivalents of the lower part of the English coal measures; between this centre and the outer edges is another set of coal-bearing strata, surmounted and underlaid by marine limestones, the whole forming the equivalent, partly terrestrial, partly marine, of the Carboniferous limestone of England. Along the western edge of this basin the strata recline at a very high angle, sometimes even vertical, and the lower series of coals have hence been called "Edge coals," in contradistinction to the upper series or "Flat coals," which lies more or less horizontally in the middle of the trough.

This Mid-Lothian coal-field is divided by the authors of this Memoir into the three following subdivisions:—

1. The Carboniferous Limestone Series, with its associated beds of marine limestone, coal, ironstone, fireclay, sandstone, and shale.

2. The Millstone Grit, consisting principally of coarse red and white sandstone and conglomerate.

3. The Coal-measures, which lie in the centre of the basin, the equivalent of the Coal-measure strata in the Midland and South-western counties of England, and in Wales, and which here include two series of coal-beds, interstratified with strata of sandstone, fireclay, clay-ironstone, and shale.

In every respect this Memoir, which is illustrated by a coloured Index Geological Map of the district, and by numerous wood-cuts, will be found worthy of an attentive study. The chapters on the Intrusive Igneous Rocks of the district, and on the Faults, will be found peculiarly instructive.

The Memoir of Messrs. Bristow and Whitaker is on a district of less striking general interest, but it is nevertheless full of information to the Geologist, and is remarkable for the clearness and neatness of its style. Indeed, all the recent productions of the Survey are highly commendable in this respect, and should be taken as an example by some other Geologists, who still seem to imagine that they add importance and dignity to their productions by producing them in a ponderous and involved style.

ROCKS AT THE MUSEUM OF IRISH INDUSTRY.

Inventory Catalogue of the Specimens illustrating the Composition, Structure, and other Characters of the Irish, British, and Foreign Rocks, in the Collection of the Museum of Irish Industry, Dublin.

THAT great branch of the science of Geology, which Mr. Jukes, in his *Manual of Geology*, defines as GEOGNOSY, is the portion of real importance for industrial purposes. It includes the mineral composition and structure of rocks (Lithology), and their physical relations, excluding all questions of age (Petrology). To Mr. Jukes, the author of this catalogue, must be given the credit of having first, in this country at least, given due prominence to this branch of Geology. Admitting the paramount im-

portance of paleontology, and the arrangement of strata in a chronological series, it cannot be denied that Geology has been prejudiced in the mind of practical miners, by a too exclusive devotion to these subjects. It is, of course, ridiculous to rail at collections of "shells;" but still it is natural that a man who knows nothing of paleontology should be impatient of that exclusive devotion to it, which alone for many years passed for Geology. When Geologists turn their active attention to Lithology and Petrology—that is, the respective mineral composition and structure of rocks, and their physical relations on a large scale—we are satisfied they will find no more zealous nor abler coadjutors than the class of practical miners.

The present catalogue, drawn up, as we have stated, by Mr. Jukes, is a valuable evidence of the attention which the subject is now receiving. It consists of two parts—the first, a catalogue of rocks collected chiefly in Ireland, with only a few specimens from other localities for comparison; —and the second, a catalogue of typical European rocks, chiefly eruptive and metamorphic, purchased from Dr. Kranz. The collection, on the whole, must be a very valuable one, and well worthy of the attention of any one visiting Dublin. The catalogue itself will be found valuable for reference.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics, des Sciences et des Arts appliqués a l'Industrie. Sous la Direction de M. Ch. de Cuyper, Professeur des Sciences de l'Université de Liège, Inspecteur des Etudes a l' Ecole des Arts et Manufactures, et des Mines. 6th year, 1st livraison, January and February, 1862.—Paris et Liège, E. Noblet.

This very valuable periodical, which appears every two months, seems scarcely inferior in the character of its articles to the *Annales des Mines.* The principal articles in the present number are On the Iron Works of South Wales, by M. E. Rollin; On the Salt Mines and Works of St. Nicolas-Varangeville, by M. L. Bronne; On the relation between the increase of the surface heated and the increase of the quantity of water evaporated; On the Machines for sawing soft rocks used in the quarries of Pyrimont (Savoy), by M. M. A. Lebrun and Ch. Demanet; On the patented Improvement in the Treatment of Iron-ores in Blast Furnaces, by M.M. Eugène Boulanger and Jules Dulait; and on the Spectrum Analysis, by Fr. Dewalque. There are besides numerous abstracts from other periodicals, and the whole is illustrated by numerous first-class plates.

UNDERGROUND MINERAL TRANSIT.

On Underground Mineral Transit. By Mr. James Ferguson. *Excerpt Minutes of Proceedings of the Meeting of the Institution of Engineers in Scotland, 3rd April,* 1861. Glasgow: William Mackenzie, Howard-street.

A short time ago a paper on "Underground Mineral Transit" was contributed to the "Transactions of the Scottish Institution of Engineers," at the request of the President, by Mr. James Ferguson. The writer announces at the outset that it is not his intention to give a complete history of the subject, but merely to allude in a general way to several of the

modes of underground transit now in successful operation; and he also limits his remarks almost entirely to what has come under his own observation.

Before entering upon any details of the subject, Mr. Ferguson makes reference to the numerous and peculiar difficulties intimately connected with all kinds of underground mineral transit, and adverts to

(1.) The various angles of inclination which mineral beds and mineral veins are found to exhibit, and at which they are worked—from a dead level, or undulated plane, upwards through every degree of inclination to the vertical.

(2.) The "breaks," "shifts," "hitches," or dislocations to which all mineral deposits have been subjected—met with in all mining operations—whereby the bearing and inclination of the strata may be at once so much disturbed as to necessitate an entire change in the direction of the roads.

(3.) The direction and gradients of underground roads as further influenced, and in some measure determined by the course of the "backs, cracks," &c. These, in sedimentary rocks, are natural vertical divisions of the strata, which must be attended to in mining as a matter involving the safety of the workman, and also the economy of the mine.

(4) The characteristics of the rocks forming the roof and pavement of the mine, which may be such as to preclude the formation of an economic drawing road. This may arise from two totally different causes:—The concomitant beds may be so very soft, or friable, that for safety they must be secured by timbering; or so very hard, that the construction of a proper road would cost more than the amount of benefit which it would yield.

(5.) The very small amount of daily traffic which the great number of the roads in any mine require to accommodate, even when the aggregate produce of the mine is very great.

Mr. Ferguson next gives a sketch of the commencement and progress of underground mineral transit.

1. Bearing System.—This system was in operation at the collieries on the "Edge" seams of coal, to the east of Edinburgh, so late as the year 1831—the only time and place where the writer had an opportunity of seeing it. The bearing system is said to have been peculiar to Scotland. Whether this statement is correct or otherwise, there is little doubt as to its having prevailed there from time immemorial up to the passing of Lord Ashley's Bill in 1843, whereby all women and boys under ten years of age were excluded from working underground. It is probable that the system had its origin in the "Edge" seams alluded to, and was confined chiefly to that locality, as there are no records of it in the west of Scotland. This mode of transit, if not the earliest, is certainly one of the rudest that can be imagined. Boys, young women, and mothers were usually employed at the beastly labour, the mode of carrying the load being precisely the same as that followed by the Newhaven fish wives at the present day. All the plant necessary for conveying minerals underground by this system was a basket or creel, capable of containing from 1½ cwt. to 2 cwt. of coals, and a strap or broad belt of sufficient length to pass from one side of the creel to the other, and round the forehead of the bearer, when the creel was upon her back; and these the bearer had to provide. In this manner was the coal taken in back loads from the place

where it was dug to the surface of the mine. At first this would be done by means of "in-going eyes" or roads from the "out-crop" of the seam; latterly pits were sunk, and the load was carried not only along the floor of the mine, but also up the pit to the surface by means of ladders or stairs, and in some cases these stairs were cut in the sides of the shaft like a corkscrew. This latter portion of the labour was early displaced by the rope and windlass, horse-gins, water power, and the other modes of raising loads vertically. When the coals, "water-free," became exhausted, and the seams were drained by shafts sunk down under the level of the natural adit, the usual method was to sink a shaft midway between the highest and the lowest portion of the breast of coal which had to be worked out. To this intermediate shaft all the coals drained were carried down from the upper section, and up from the lower section, to the pit's bottom. At the bottom of the pit the creels were emptied into round tubs, baskets, or boxes of sufficient size to contain two or more back loads, and from thence were taken by the winding engine to the pit bank. The first step taken to improve this system was the introduction of rails, and the conveying of the large baskets or tubs, upon a truck, along the level roads to stations, where the bearers were sooner relieved of their load. Mr. Dunn, one of the Government inspectors of mines, in his work on the "Origin and Progress of Coal Mines," states that the load carried by the bearer was from 200 to 240 pounds, and the distance which it was conveyed was about 2,800 yards per day; in other words, forty loads per day carried a distance of seventy yards. For performing this labour the bearer was paid from 1*s.* to 1*s.* 2*d.* per day. The following statement, which has been obtained for the purpose of preparing this paper, is somewhat different from that published by Mr. Dunn, and corresponds with what is published by Mr. Bald, in 1812:—

1. Average distance carried .... 400 yards.
2. „ weight per load .... 1½ cwt.
3. „ number of loads per day 24

Which, calculated at 1*s.* 2*d.* per day, gives 34·1*d.* as the rate per ton per mile for cost of conveyance. Whilst in this statement the details of labour are different, the rate of remuneration is the same as given by Mr. Dunn, namely, 1*s.* 2*d.* per day, when colliers were being paid at the rate of about 2*s.* 6*d.* per day. Mr. Bald, mining engineer, Alloa, the worthy father of the profession in Scotland, in a work entitled "Inquiry into the State of the Women who carry Coals underground in Scotland, known by the name of *Bearers*," published in 1812, says that—carrying 1½ cwt. as a load—the daily labour performed for five days each week was—

On the level at the pit bank .... 480 yards.

On a rise of 1 in 12 feet, that is, a rising gradient at the rate of a little more than 146 yards per mile . 3,600 „

The vertical distance being .... 936 „

Mr. Bald adds, the wages paid for this work was *eightpence per day*. Another statement is given which, as well as the above, came under Mr. Bald's personal observation, in which a load of ¾ cwt. was conveyed 8,400 yards, with a perpendicular rise of 700 yards, as a woman's daily work, the distance passed over with the load being at the rate of 38·9*d.* for conveyance per ton per mile. The bearer, in addition to the labour of carrying a load at the rate of 38·9*d.* per ton per mile, raised 5 cwt. to the height of 200 yards, being one-fourth of a day's work for an able-bodied man. In

an article which he contributed to Brewster's "Edinburgh Encyclopædia," published in 1830, he says, "The weight the women carry is from 1½ to 2 cwt., and in some cases they have been known to carry 3 cwt. At several collieries in Scotland 60,000 tons a-year have been carried in this way." The writer has alluded to the mode of bearing under its most favourable aspect; that is, when there was sufficient space to carry the back load in the easiest manner for a human being; but the wicked abuse did not stop short at this stage of degradation for the bearer. Being reduced into a system, it was introduced into the thin coal seams also, where the body had to be bent downwards and distorted whilst the heavy load was put upon it, the poor bearer performing the task in a manner disgusting even to think about. The following description of how a load was carried in these thin coal seams is from the mouth of one who in her youth had been so employed:—"The creel was first filled, and whilst the bearer was stooping and bending forward the loop or bight of the strap fixed to the creel was passed over her back and forehead, and thereby was the load sustained, the length of the strap being so adjusted as to allow the creel to hang down behind over the body, partly resting upon it, but only kept from falling by the strap pressing against the forehead." In such a position as we have attempted to describe, with the highest part of the back and the top of the load nearly on the same level, the head and shoulders of the bearer were necessarily still further depressed. An addition to the load was now made by placing a block of coal upon the neck between the shoulders, whereby the muscular action operating to keep the head down was materially assisted, and the tendency of the overhanging load to draw the head upwards was in a certain degree met and provided against; or, as our informant stated, "it helped to balance the creel." Whatever evils yet linger amongst us of this sort, that one is now gone for ever, and with it several curious incidents of social life which it engendered. The supply of bearers being limited almost entirely to those who had been trained to the labour from early youth, there was a constant demand for them; and a stout lass who could carry a few pounds more than her neighbours could *choose* her husband from the young colliers of the mine. It is also told that upon those interesting occasions, which are from their nature peculiarly feminine, the husband rested until his wife was able to resume her share of the underground toil.

II. Sledge System.—The first step taken to lessen the labour of underground transit by the application of mechanical skill, was the introduction of the sledge or "slipe-hutch"—the name given to any kind of box, with cradle feet, used for conveying mineral underground. The sledges were drawn along the natural floor of the mine by men, women, and boys; and where animal power could be profitably applied, that power was also made use of. The sledges were shod with iron, and contained from 1¼ to 5 cwt., according to the inclination of the road, the nature of the pavement, and the motive power. Where the pavement or floor of the mine was soft, slabs from round trees, wattles, and other such things were laid down across the line of road to reduce the friction. The harness used for this kind of work, when manual labour was applied, consisted of two straps passing over the shoulders, the four ends being connected with a chain to which the load could be attached. On a well-kept road, with a rise of about 1 in 8, the labour of dragging a gross load of 7½ to 8½ cwt. downwards, is nearly the same as the taking of an empty hutch in the upward direction, the weight of the empty hutch being from 2 to 2½ cwt. On a level road it requires the utmost exertion of an able-bodied man to drag a gross load of 8 cwt., and the labour cannot be maintained for any considerable distance at one

time. This mode of transit upon a level road is most laborious and exhausting, involving a continuous dead pull, where not a single inch of ground can be passed over without a corresponding effort. When engaged in it the drawer may be seen stretched forward nearly into a horizontal position, his hands clutching at the pavement, or pressing against the sides of the passage, to aid his slow progress, every muscle as rigid as iron, and strained to the utmost. The sledge mode of transit was the only one in use at a considerable colliery in Scotland within the last 15 years, and as the labour of drawing the coals was performed by contract, and perfectly unconnected with the labour of digging them, a correct idea is obtained of the cost of conveyance by this system. The quantity conveyed in the hutch or sledge at one time was little more than 1¼ cwt., *less*, it may be noticed, than the weight which the collier put upon his daughter or wife for a back load. Without going into the reason why such light loads were drawn, we shall at once state that, for the drawing of 20 score—21 being considered a score—that is, for the drawing of 420 of these light loads the distance of 60 yards, the sum of 8*s*. 4*d*. was paid, and also that these 420 loads only weighed 26 tons 5 cwt. For every additional 24 yards which the 26 tons 5 cwt. was conveyed, the sum of 4*s*. 2*d*. was paid. Thus, with wages at about 2*s*. 6*d*. a day, we have—

1. Rate per ton per mile when conveyed a distance of sixty yards .... 9*s*. 3½*d*.

2. Rate per ton per mile when carried a distance of eighty-four yards .... 9*s*. 11¾*d*.

At Auchinheath Colliery, about thirty years ago, the system in operation was a combination of sledge work and railway. The flat long boxes weighed about 2½ cwt., and when carefully filled carried a load of 5½ cwt. The price paid for drawing 300 yards, or thereby, upon the level railway, with 100 yards of sledge work to the rise of the level, was one shilling per ton, or about 3*s*. 8¼*d*. per ton per mile, wages being 4*s*. per day. The increased remuneration for sledge work was at the rate of fourpence per ton per 100 yards, or at the rate of 5*s*. 10*d*. per ton per mile.

HORSE SLEDGES.—Horses, mules, &c., were from an early period made use of in coal mines to drag the sledges instead of men. The horse sledges contained from 5 to 6 cwt., and were sent direct from the working faces up the shaft to the pit-bank, as filled by the colliers. This was a step in the proper direction, animal labour being substituted for severe manual toil, and refilling was dispensed with. Being without details of the cost of sledging by horses, it is only from general recollection the writer states that he is satisfied that this mode of transit was by no means an economical one; and of all the kinds of labour to which horse power has ever been applied, underground sledge work was one of the most wasteful and cruel. The drawing chains of the horses' harness being attached direct to the ends of the cradle foot of the sledge, jolted from one side to the other, as it proceeded along the uneven track, striking against the pillars; or as it was hurriedly conveyed down the rugged inclines, the horse was tugged and twisted in every direction, and cut and bruised in every possible manner—now lashed forward to keep clear of the descending sledge, and the next moment straining to take it onward over some newly-fallen portion of the roof—first one drawing chain and then the other having all the strain upon it, as the load was shifted from one galled shoulder to the other, in taking the dark angular passages of the mine. The drivers were usually boys, all tasked to a certain number of "raiks" per day, each striving to outstrip his neighbour, if by lashing and reckless driving he could possibly do it.

SLEDGE AND RAIL.—The first step towards improvement upon the sledge system, as in the case of "bearing," was the introduction of rails upon the level roads, a low-wheeled truck being used to carry the sledge or box containing the load. The men or horses, as before, dragged the sledges from the working faces to a station upon the main road, where a bench, the same height as the truck, gave facility for placing the loaded sledge upon it. The gauges of the early underground-railways were exceedingly narrow (in some cases not more than fifteen inches), and, on account of this circumstance, it is presumed, men were at first employed to push the wheeled truck, with the loaded sledge upon it, from the station to the bottom of the shaft. As the advantages of railways were very soon seen, the introduction of a wider gauge, and a horse to drag a train of loaded trucks, naturally followed. In addition to this, the railways were extended from the stations on the main roads into each of the working faces, the sledge work being restricted to the rise workings, where, from the steepness, a truck with the sledge upon it could not be taken. The use of sledges is now entirely confined to mines where the inclination of the strata is more than one in six, and in very few cases are the sledges sent up the shaft to the bank, as was done until very recently almost every where. Where the inclination of the sledge-track approaches the angle of forty degrees, the drawer finds it to be less laborious to carry the sledge upon his back than to drag it behind him up the steep incline. In such cases two sledges are sometimes used in each of the working faces, with a chain and pulley, whereby the empty sledge is dragged up the incline by the full one, the drawer guiding the full one in the descent. The chain and pulley are fixed to a tree, which is jammed hard up between the roof and pavement, and is removed upwards from time to time as the working face advances.

III. BARROW SYSTEM.—Previous to the introduction of four-wheeled trucks and rails, wheelbarrows were partially in use as an improvement upon the sledge. "The inconvenience felt in the transfer of the coals from the barrow to the tub or basket in which they were to be drawn up the shaft," says Mr. Dunn, "originated the tram, with wooden wheels, upon which the coals could be conveyed in a tub or basket from the working faces to the top of the pit without transfer. The barrow-ways suitable for the tram consisted of three planks, the upper one forming the guide for the tram-wheels.

IV. RAILWAYS AS NOW CHIEFLY USED UNDERGROUND IN SCOTLAND.—It is foreign to the object of this paper to attempt giving a history of the many rude appliances which were the prelude to the railway of the present day. Wooden rails and sleepers were introduced in the north of England between 1632 and 1649. In 1676 they are described as being made by laying rails of timber from the colliery to the river, exactly straight and parallel. Within the last twenty years, railways, formed with hard-wood timber alone, or of timber covered with thin bars of iron, were to be met with at many of the small collieries in Scotland, and also the carriage with its timber axle and wheels. The first certain account of cast-iron being used for rails is met with in the books of Colebrooke Dale Iron Company. From these it appears that on the 14th November 1767 between five and six tons were cast as an experiment, under the superintendence of Mr. Curr. Mr. Curr, in his *Coal Viewer and Engine Builder*, published in 1797, claims to have invented and introduced cast-iron tramways, or plate rails, at the Sheffield Colliery in the year 1777, that is, twelve years after the experiments made by him at Colebrooke Dale, in Shropshire. The earliest notice which we have of malleable iron being used for rails is at Walbottle Colliery, near Newcastle-upon-Tyne, partially laid down as early as 1794, and completed by Mr. C. Nixon in 1805. John Neilson, of Oakbank, near Glasgow, laid the first malleable-iron rails in Scotland at Hurlet, about the year 1818. The general introduction of railways underground did not at first very much modify the arrangements

for collecting and conveying the produce of the mine. The low-wheeled truck was long retained, with the basket tub, or sledge, placed upon it, containing the load; and where horses were employed, two or more loads were placed upon one truck, being lifted from the small truck and placed upon the large one by means of a small crane. The inconvenience of this method is evident; and it is again to Mr. Curr, of Sheffield Colliery, that we are indebted for the next step in the way of improvement by the introduction of wheeled carriages as now used,—a most decided improvement upon the truck with the detached basket or tub containing the load. Previous to the wheeled carriages being sent up the shaft, an arrangement had to be made to prevent breakage, and at first they were guided by conductors of iron, stretched from the pit-head framing to the bottom of it, and made as tight as practicable. These conductors, formed of iron bars, united by means of links or screws, have been used in some of the English collieries from the time of their first introduction until the present day; and such conductors are still partially made use of, with wire ropes substituted for the bars of iron. The invention of the cage was necessary to perfect the plan of taking the loaded wheel carriages up the shaft, and by it this can now be done at any speed with the utmost safety. These cages or platforms may be made to contain any number of wheeled carriages, and are made to carry from one to eight at a time. They are permanently attached to the winding ropes, and kept in their position by perpendicular wooden guides, fixed to the sides of the pit. The cage and guides first introduced into Scotland about twenty years ago are now almost universally used, along with the wheeled carriages, for conveying the load direct from the working faces to the pit-bank. It does seem strange why the fixed wooden guide was not first discovered, being at once the best, the simplest, and the cheapest. While the guides or conductors have been improved, our underground rails and railways throughout three-fourths of the Scottish mines are very much what they were when first made by Mr. Curr about seventy years ago. The cast-iron sleepers introduced by Mr. Curr have been for a long time abandoned; in other respects they are precisely the same. The reason why so little attention has been paid to so important a matter may be found in the fact that hitherto the greater number of the pits in Scotland have been so easily sunk that it was more profitable to sink a new than to make and maintain an extended system of good roads from an old one; and this the more from the irregularity and disturbed character of the mineral fields in Scotland rendering any uniform plan of working an utter impossibility. With few exceptions, cast-iron plate rails and wooden sleepers are used in the railways of the mines in Scotland. These rails weigh from 50 to 60 lbs. per lineal yard of railway, and cost just now about 85s. per ton; and including sleepers, nails, and laying down, the mile of railway costs only about £220. From the difference of weight in the rails, when malleable iron is used, the cost per mile is nearly the same. The gross weight carried upon these rails is seldom more than 10 cwt., and even with that load the breakage of cast-iron rails is very considerable. The carriages used in the coal-mines of Lanarkshire weigh from 2 to 2½ cwt., and are calculated to contain 4½ cwt. of riddled coals, free from dust and small coals, or about 6 cwt. of useful load. Wheels are used both of malleable and cast iron, and vary in diameter from 8 to 12 inches, being sometimes fixed to the axle, and at other times loose upon it. In many places the drawing of coals, as well as the getting of them, is performed by the collier, and in such cases there is some difficulty in ascertaining the actual cost of conveyance; in others the drawing of the coals is performed by men specially employed for that purpose, with horses to convey the trucks along the level roads and up inclines, where, from any unavoidable cause, these are necessary in the operations of the mine.

The following particulars are the result of inquiries made regarding the cost of conveyance in some of the collieries in the Monkland district, where

drawers are employed, and no horses introduced:—1. In pits where the metals are nearly horizontal, the distance travelled per day with the load of 6 cwt. is from 4000 to 6000 yards, and the cost per ton per mile from 2*s*. to 3*s*. 2*d*. 2. In pits with the metals inclined upwards, with a rise of about 1 in 6, or an angle of 10°, the distance travelled with the load of 6 cwt. per day is from 3000 to 5500 yards, the cost per ton per mile varying from 2*s*. 4*d*. to 4*s*. The difference in this case may arise from the greater length of rise roads. 3. In pits where the drawing of the load is upwards, and where, from other local causes, the roads have to be laid off with bad gradients, the distance travelled with the usual load per day varies from 1250 to 3000 yards, and the cost per ton per mile is from 4*s*. to 7*s*.

The following particulars are from collieries on the Lesmahagow line of railway, established within the last few years, where the drawing is a combination of manual and horse labour:—1. Distance travelled with the load on rise roads, 170 yards; distance travelled on level roads, 220; total, 290 yards. Average cost per ton per mile, 1*s*. 3¾*d*. 2. Distance travelled with the load on rise roads, 250 yards; distance travelled on level roads, 374; total, 624 yards. Average cost per ton per mile, 1*s*. 7*d*.

At Auchinheath and Craignethan gas-coal works, in the parish of Lesmahagow, an attempt has been made to improve upon the system of underground transit as now at work in the west of Scotland. The carriages used are 4 feet 9 inches long by 3 feet wide inside, and 8 inches deep, and weigh, when new and dry, 4 cwt. 1 qr. 14 lbs., with 12-inch cast-iron wheels for edge rails. The average load of coals, taken from the weigher's book at the pit mouth, is 13 cwt. In drawing ironstone or refuse the average weight is about 17 cwt., although a load of 20 cwt. is sometimes put into the wagons and sent up the shaft. Common malleable-iron bars are used for rails, 2 inches by ⅝ths on the rise roads, and 2 inches broad by ¾ths thick on the more permanent level roads, being notched into the intermediate sleepers, with cast-iron chairs at the joinings. The cost of a mile of railway is £300. In laying the bars, the joinings of opposite rails are never made on the same sleeper. Some time previous to the introduction of horse labour, about eighteen months ago, a careful account was taken of the work performed and the cost of it. The average length of the level roads was 376 yards, the shortest being 120 yards, and the longest 611. The average length of the rise roads was 118 yards, the shortest being 12 yards, and the longest 283. The greatest distance travelled by a "drawer" per day, taking the average of a fortnight's labour, was 9 miles 91 yards; the general average of travel was between six and seven miles, this including going out with the load and returning with the empty wagon; but it must be noticed that the pushing of the empty wagons up the rise roads was the most severe portion of the labour performed. At the time when the cost was calculated, the employment of a boy to assist the "drawers" up the rise roads had become almost universal, and the price paid for drawing was 4*s*. per day to a man, and 2*s*. per day to a boy for one load. The writer is satisfied that in this case the distance was exceeded at which, under the circumstances, manual labour should have been employed, the number of "drawers" upon such a length of road causing much time to be lost in waiting upon each other, whilst on the level roads a boy was not required, although the labour had become too severe for one man to perform the usual and requisite number of journeys. The cost per ton per mile varied from 2*s*. to 3*s*. 8*d*, at 6*s*. per day for the drawing of one load, or at the rate of from 1*s*. 4*d*. to about 2*s*. 6*d*. per ton per mile when 4*s*. per day was paid. Horses are now introduced, whereby all the labour of drawing is performed, with the exception of taking the loaded wagon from the working face to the foot of the rise roads. Previous to giving the details of cost, it may be noticed that the system is at work where the arrangements of the mine were not specially prepared for it, and it is already seen where several improvements

to lessen cost can be introduced. Considering that remarks on a matter so local are unsuited for a paper such as this, the details of the system are given precisely as they are now in operation, with the labourers' wages at from 3*s*. 6*d*. to 4*s*. per day. 1. Labour performed by men—taking the loaded wagons from the working faces to the foot of rise roads, and walking back the distance the load is conveyed, is paid at the rate of 1·5*d*. per ton, or 16·6*d*. per ton per mile. 2. Labour performed by ponies, that is, taking the wagons up the rise roads and returning the same distance without any load, say with turnings 7 miles per day, now costs at the rate of 2·5*d*. per ton, or 2·3*d*. per ton per mile. 3. Incline work, 1·6*d*. per ton, or 8·7*d*. per ton per mile. 4. Train horse with driver, &c., travelling from twelve to fourteen miles per day, 8*d*. per ton, or 2·6*d*. per ton per mile. The total cost per ton by horse labour is 6·4*d*. per ton, or at the rate of 1*s*. 1¼*d*. per ton per mile, the average length of roads being taken at 836 yards. The average cost of manual labour previous to the change was 9·6*d*. per ton, or at the rate of 2*s*. 10½*d*. per ton per mile; but at that time the distance conveyed was considerably less, being only an average one of 494 yards.

The following particulars are from the Coltness Iron Company's Pits, Wishaw district:

Pit No. I.—Output for 4 weeks, 4934 tons.

	£	s.	d.
Cost of transit:—Horses (5 at 3*s*. each per day), 24 at 15*s*. =	£18	0	0
Bottomers	6	14	4
Roadsmen	8	8	0
Ostler	3	12	0
Drawers	55	5	10
	£92	0	2

				Per ton per mile.
49 men draw 400 yards, 2912 tons, cost	£54	6	2 =	12·64*d*.
34 „ 800 „ 2022 „	37	14	0	9·84*d*.
Average				11·24*d*.

Pit No. 2.—Output for 4 weeks, 5687 tons.

	£	s.	d.
Cost of transit:—Horses (5 at 3*s*. each per day), 24 at 15*s*.	£18	0	0
Bottomers	7	12	0
Drawers	31	19	5
Drivers	8	16	0
Roadsmen	12	18	6
	£79	5	11

				Per ton per mile.
45 men draw 300 yards, 2641 tons, cost	£36	16	6 =	19·63*d*.
52 „ 650 „ 3046 „	42	9	5	9·06*d*.
Average				14·34*d*.

The following particulars are from the Staffordshire district, where "skips" are used, and are taken from a certain pit, which is considered to present a fair example of the cost of haulage. The *data* for the calculation are 7288 skips, weighing 345 tons 12 cwt., conveyed the distance of 645 yards; that is, the average distance of the working faces from the bottom of the pit, at a cost of—

	£	s.	d.
18 Horses, at 6*s*. 6*d*. =	£5	17	0
18 Drivers, at 2*s*.	1	16	0
Roadsmen	0	4	0
Horse-fettler or groom, &c.	0	3	6
Cager or hanger-on	0	3	6
	£8	4	0

This makes the cost per ton per mile 15·55*d*.

The writer has already alluded to the numerous and peculiar difficulties intimately connected with all kinds of underground mineral transit; and to these may be attributed the slow progress of improvement, the light loads conveyed, and, generally, the high cost of conveyance per ton per mile, as compared with railway-carriage above ground. One of the difficulties—perhaps the chief one—is the utter impossibility of maintaining uniformity of gradient; and the practical result of this want of uniformity is evident, the load having to be regulated by the steepest part of the road over which it has to be conveyed, and in most cases this difference being very considerable. We have said the load has to be regulated by the steepest part of the road; and this is the case, whether as regards the pushing of the load upwards or the lowering of it down, when the inclination is more than 1 in 6, and the load from 6 to 8¼ cwts. gross. When an arrangement can be made to concentrate a number of rise roads into one, a self-acting incline, regulated by a brake, is a usual and approved mode of lowering coals, where the loaded hutches in descending on one line of rails take up the empty ones upon another line. A similar arrangement of roads, with motive power at the top of the incline, may be used when the load has to be taken upwards. Where the gradient is such that the descending empty carriages "overhaul" the rope, one line of rails will be found sufficient for a very large output, if fitted up with the necessary motive power. Where the inclination is less, and the empty hutches descending do not "overhaul" the rope, a double line of rails is again necessary, or some other application of a "tail-rope" to take the empty carriages and the drawing-rope to the lowest part of the mine for a new load. Or the rope may be worked over pulleys at the top and bottom of the incline with a slow continuous motion, the ascending loaded carriages being upon one line of rails and the empty descending ones upon the other, arrangements being made for attaching and detaching at any place when necessary. Where the natural mode of working a bed of coal will admit of the working faces being carried on parallel to the main level road, or nearly so, a self-acting incline, with an endless rope, to which the loaded carriages could be attached, and from which the empty ones could be taken at any place upon the incline, would be an economic and novel application (so far as the writer knows) of this mode of transit—this plan being suggested by the description of drawing loads upward in a similar manner.

For examples of what can be done underground under favourable circumstances, as regards the extent and regularity of the coal-field, we can refer to vols. iii. and v. of the *Transactions of the North of England Institution of Mining Engineers.* It is there stated that engine planes have been worked of a length of 2519 yards, or nearly one and a half miles; and 106 tubs, each containing 8 cwt. 2 qrs. 8lbs. of coals, and weighing 482 lbs., or a gross weight of nearly 13 cwt., were conveyed in one train at a rate of speed equal to nine miles per hour upon an incline of one in five. In the same volumes will be found a paper by Nicholas Wood on a plan of working coal-fields entirely by a system of self-acting and engine-worked inclines.

Besides manual and horse power, steam power, compressed air, and water have been and are used for driving winding machines underground. At St. Helens' Auckland Colliery, Durham, steam is conveyed first down a shaft of about 150 yards deep, and from the bottom of the shaft down an incline of fifteen degrees a distance of 1100 yards, making a total distance of 1250 yards. From the result of this experiment it appears that a pressure of 40 lbs. per square inch is required to force steam at the rate of 64·5 feet per second through 1250 yards of 5-inch pipes, and that the loss by friction and condensation under such circumstances is 80 per cent, the pressure being reduced from 40 lbs. to 8 lbs. per square inch. Mr. Wood obtained no practical results from steam of 35 lbs. per square inch pressure, conveyed 1012 yards through 4-inch pipes. Compressed air is used as a

motive power at Govan Colliery, near Glasgow. The steam-engine used for compressing the air is at the pit bank; the compressed air is carried down the shaft 92 yards, and from thence to the place where it is used, a distance of 706 yards. A paper upon this engine, by Mr. Charles Randolph, Glasgow, was read at the Glasgow meeting of the Institution of Mechanical Engineers, in September 1856.

Where there is surplus pumping power, water with a high pressure may be taken from the engine pump, conveyed along the passages of a mine, and used as a motive power for winding with any kind of suitable machine.

For working out a detached area of coal—where the cost of sinking a pit from the surface would be more than the profit on the quantity which it contains, and where, from any cause, the introduction of steam or any other motive power would also be too expensive—a wire rope may be passed down a bore from the surface to the place where the lifting power is required, being worked by steam or any other available means.

The writer has introduced these observations on motive power to show that where the object in view is of sufficient importance to demand an effort from the inventive faculty of the engineer, the necessary mechanical appliances are not wanting. What we most require, however, is a simple, safe, and expeditious mode of working inclines at a high angle, say with a rise at the rate of 1 in 1½ or 1 in 2, and that with loads of from 15 to 20 cwt., under the control of one man. Such a machine, to be really useful, should be of such a description that it could be applied to the working-roads as these were cut forward, and also to any place upon a road where, in consequence of "hitches," or any other cause, a steep gradient had been introduced. There are many ways, perhaps, in which this can be done, but *none* has yet been discovered sufficiently cheap and simple to warrant its universal adoption, from its merit being clearly seen and felt, as in the case of Mr. Curr's rails and wheeled carriages. Self-acting inclines are the nearest things we have that are available, and might be used advantageously to a much greater extent than they now are, notwithstanding the cost of the drum, &c., or the still more simple arrangement of a single pulley—the fixed retarding force being a certain number of the wheels made fast, whilst the man going along with the loaded hutch holds back or pushes forward, as may be required, to keep up a uniform motion. The writer has tried several modifications of the incline—1st. A double road worked by single length of chain, passing round a horizontal wheel, with friction strap upon it, and a second strap to press upon the chain where more retarding power was required. 2d. For short and very steep gradients such as an angle of 45°, where the nature of the roof precluded the idea of making any opening sufficiently wide to admit of a double road, a line of rails was laid for running a counter-weight upon, which assisted the friction brake on lowering the carriage when loaded, and was of sufficient weight to raise it when empty. 3d. A single road and pulley, with the chain running under the descending wagon, until the two meet upon a platform midway. At this place the empty wagon is removed from its position below the loaded one, and put upon the rails above it, the chains being at the same time adjusted so as to run under the ascending empty wagon. The latter mode may be applied with advantage where the work to be done does not warrant the erection of a proper machine.

Where hitches in the strata are numerous, and the field unexplored, in drawing loads, such as from 12 to 15 cwt., it will be found the cheapest plan in many cases to go over these at a high angle—45°, or whatever is the angle of the rise, or slope of the dislocation. To work this a small crane can be used, whereby one man can lower the loaded wagon and take up the empty one with ease.

When it is kept in view that the present yearly output of coal in Scotland is upwards of 10,000,000 tons, and the output of limestone, ironstone, and other minerals will be about 3,000,000 tons, an idea can be formed of the

magnitude and importance of the matter to which attention has been directed. Viewed as a money matter, and taking 1*s.* per ton as the average sum paid for underground transit on all minerals raised, the total amount is £650,000, although from the statements here given perhaps £1,000,000 would be nearer the real amount.

Notes, Queries and Correspondence.

[We need scarcely say that we cannot hold ourselves responsible for the facts or opinions of our correspondents; although we shall make it a point to endeavour to exclude those which are obviously inaccurate or fallacious, as far as is consistent with our wish to encourage the freest discussion.]

DR. PERCY'S METALLURGY AND NAPIER'S PROCESS.

Sir,—Will you allow me a little space in your Magazine for a few remarks upon Dr. Percy's letter in your last Number upon my notice of his book; or rather, of a small portion of his book. If the castigation which the doctor has imagined himself giving me has relieved him in any way (it could hardly be done for any other purpose), I will personally rejoice, although it is done in bad taste; for, he having admitted the positive correctness of some, and probable correctness of others, of my statements, it would have been more in keeping had these admissions been prefaced with expressions of gratitude. For the doctor, being desirous, no doubt, of making his book as free as possible from gross errors, should be thankful, when such have got in, to have them pointed out.

In reference to that part of my remarks where I gave it as my opinion that the doctor had not treated Mr. Napier's experiments on calcination in the way one would have expected of him, he says, "My reasoning is based on Mr. Napier's own analytical data, and if my conclusions be erroneous, I should be glad to see them disproved." This is exactly what I objected to,—the assumption of such a position over a fellow-worker in the same field. It is now several years since the doctor made the criticisms referred to in a part of his public lectures; and, if my memory serve me right, in the same language as printed in his book. I still hold as my opinion, that if, during these years, the doctor had got some of his Swansea friends to furnish him with samples taken out of a calcining furnace, as Mr. Napier says he did, and put the matter to the test, he would have done better service to the cause than he has done.

The paragraph on Napier's patent, its success or failure, quite satisfactorily shows that the doctor has ventured upon ground beyond his personal knowledge. He has either forgotten, or did not know, that two patents were wrought at the Spitty works; and all the information he has received about these works has been unwittingly confused and identified with only one patent. He might have suspected that his information was not very consistent about the patents, if the Company has been at the expense and trouble of obtaining an extension of a patent which he made out they had been obliged to abandon from unfavourable balance sheets. The doctor says, that I having admitted that Napier's process was abandoned is the important fact. This kind of special pleading will not do. I never questioned the fact of the discontinuance of Napier's process; but contradicted the incorrect statement made in Dr. Percy's book, which he cannot disprove.

I accept the doctor's explanations as to the meaning he intended to convey in the paragraph in reference to the estimates of the copper in the furnace bottoms; but it renders that part the most ambiguous portion of the book, for I cannot suppose any reader to take out of it the meaning the doctor intended to convey. The estimation of furnace bottoms is an interesting subject, and one the doctor might have made a very instructive article upon. Furnaces have individual peculiarities, like many things else, in working, absorbing, and other qualifications, which an intelligent manager observes and studies; and he, or other practical men long in the works, and familiar with the furnaces, are the most able to give any thing like an approximate estimate of the value of the bottoms. An estimate made by strangers is much less to be relied upon, and smelters know this. The results obtained by purchasers prove the remarks just made; for I believe neither of the men who estimated the Spitty furnace bottoms were capable of falsifying their estimate.

I think the doctor will not fail to see the justness of my remarks, that volunteering such information, apart from all the counteracting circumstances, is not consistent with the true spirit of the book, and is damaging to its character; and I am sorry to say this is not the only instance where statements are volunteered a little out of the rules of propriety for a book of merit and pretension. While I say this, I can also say that few of its readers will appreciate the book for its intrinsic worth as a whole more than I do.

An Old Smelter.

COPPER SHEATHING.

Sir,—The article upon Copper Sheathing in Dr. Percy's *Metallurgy* is full of interest, and strikes me as giving strong evidence of what I have long believed,—that our knowledge on this subject is very defective, and reflects little credit on us as a practical people. When the names of Davey, Daniell, and Miller are given in connection with this subject, it might appear to be a sufficient guarantee that full justice has been done to the inquiry; but this is really not so, for their investigations have been too limited for the requirements of the inquiry. It is remarkable how few analyses have been made on the subject; and Dr. Percy could do no greater service to the Navy, and to the shipping interests of the country generally, than by devoting a portion of his time to this important subject.

To say that a vessel was sheathed with copper made from a mixture of Cornish or other ores, and that it lasted for such and such a time, is not the class of inquiry which will satisfy chemists and metallurgists at the present day. Dr. Percy merely repeats a sort of popular prejudice, that the great deterioration of the copper sheathing dates from the introduction of foreign ores into this country. But there is really no evidence to show that these foreign ores contain any thing that the Cornish ores do not contain; on the contrary, the Australian ores are known to be of the best and purest description. My opinion is, that the deterioration of the sheathing since 1833 is connected with the operation of Muntz's patent, which came into use at that period, and which has been gradually extending, until, at the present time, all the copper smelters have it in use. The manner this process affects the general character of the copper is this: the copper for making the yellow metal is necessarily *selected*, and consequently, the portion of regulus left alter the selection being less pure than the selected portion, it follows that the copper made from it is inferior to that which would have been produced from the same ore if no selection had been made, and the whole had been brought into a state of tough copper. It is evident that such a process of selection unavoidably tends to deteriorate the quality of the copper used for ordinary purposes; for all the copper left after selecting is

not converted into *tile copper*, but as much of it as will roll is made into sheet, for sheathing and other purposes. I am convinced that a thorough analytical investigation into the whole question of sheathing would prove this view to be correct, and show that a homogeneously pure copper sheathing will last much longer than copper made from a great number and variety of different regulus, left from the selecting process.

Your obedient servant,

METALLURGIST.

Woolwich, March 12, 1862.

Mining, Quarrying, and Metallurgical Intelligence.

MINING ASSOCIATION OF GREAT BRITAIN.—A meeting of this Association was held at the Craven Hotel, London, on Friday, March 7, when a considerable number of gentlemen, representing different districts throughout the country, were present. Mr. Nicholas Wood, the chairman of the Association, presided, and several matters of great importance were brought before the meeting, among which were the "Accidents Compensation Bill" and the "Parochial Assessment Bill." With reference to the first of these measures, it was resolved that steps should be taken to oppose it; but no resolution was come to respecting the second, it being deemed more expedient to wait until the select committee appointed to inquire into the matter should begin to examine witnesses, when, if necessary, evidence might be offered touching the effect the measure would probably produce on the interests of mine-owners. Other subjects of interest came under discussion; but the meeting declined to take action in connection therewith until they were reduced into feasible proposals. On Saturday afternoon the chairman, accompanied by several members of the Association, had an interview with Sir George Grey, the result of which was considered upon the whole satisfactory.

CORNWALL AND DEVON.

The Duchy of Cornwall account of revenues for 1861, just laid before Parliament, shows:—Balance from previous year, £9273 16*s.* 11½*d.*; rents and profits of courts, £32,288 11*s.* 8½*d.*; royalties on Somersetshire coal mines, £2899 5*s.* 11*d.*; royalties, dues, and rents of mines and quarries in Cornwall and Devon, £6992 19*s.* 5*d.*; annuity from Consolidated Fund in lieu of tin coinage dues, post groats, and white rents, £16,216 15*s.*; dividends on stock, £2367 9*s.* 4*d.*; interest on balance of money expended in the purchase of toll tin, lease, and expenses, £554 1*s.* 3*d.* = £70,592 19*s.* 6¾*d.* Payments to H. R. H.'s treasurer, £30,840; purchase of copyhold at Fordington, £1299 18*s.* 11*d.*; expended for the benefit of the estate, £2281 17*s.* 2¾*d.*; allowances to duchy tenants, &c., £3182 8*s.* 4½*d.*; sundries, including superannuation allowances and annuities, donations, and charities, &c., £2061 9*s.* 1*d.*; expenses of management, £6495 17*s.* 11*d.*; leaving credit balance, £23,801 8*s.* 0¾*d.* The balance at the bankers' is £14,000 higher than at the end of the preceding year. The amount of money invested in Government stocks is £85,208 8*s.* 10*d.*, which has gradually accumulated from enfranchisements and sale of estates, and principally from charges similar to those on the receipt side of the above revenue account.

Mr. Robert Temple has been appointed Secretary to the Commission nominated to inquire into the condition of metallic mines. The Commission have now received their formal instructions from the Home Office,

and have established themselves in Old Palace Yard. The name of Mr. Richard Davey, M.P. for West Cornwall, has been substituted for that of Mr. J. D. F. Davie in the Commission.

The continued fall in the standard of tin-ore is becoming serious for the large producing deep mines, and a feeling of dissatisfaction is beginning to be expressed at the smelters. There is talk of some large mines—such as Dolcoath—again repeating an operation tried with success (as the miners conceive) before; that is, the "stocking" of a portion of their tin for a better price.

It would be a curious task to trace the history of some of the numerous mines in these counties which have recently been abandoned, under the pressure caused by the recent absence of speculative feeling. We propose, in an early Number, giving our readers a history of this kind, beginning with Great Wheal Alfred. We also propose giving regularly, after the present Number, a description and history of all new concerns proposed to be brought out. There are several now on the *tapis*, viz. Wheal Abraham and Crenver, Wheal Neptune, Catheral, and a few others.

WALES AND THE BORDERS.

South Wales.—The inquest on the Cethin Colliery accident has resulted in the following verdict: "In the inquiry into the cause of the death of Samuel Jones and others, we find, 1st, That the ventilation of No. 1 Cethin pit was deficient in quantity, badly arranged, and liable to frequent interruption; 2d, That the viewer disregarded the 1st general rule, and also permitted that special rules, Nos. 16, 18, 24, 26, 31, 34, 37, and 63, to be generally disregarded by his officers; and we find a verdict of manslaughter against John Moody."

The evidence of Mr. Thomas Evans, Government Inspector of the district, of Mr. Lionel Brough, Government Inspector of the West of England, and of Mr. Kenyon Blackwell, the Commissioner sent down by the Home Secretary, all concurred in stating that the ventilation arrangements were defective. Mr. Evans said: "I do not think that the distribution of the air is well arranged, and the ventilation is too nearly balanced, and not sufficient to meet extraordinary circumstances; such as the condition of the atmosphere, falls, or other obstructions." With regard to the relation between atmospheric pressure and explosions, the following observation of Mr. Brough is of considerable interest: "I have only to state that much observation has been given to the subject, and the fact of reduced atmospheric pressure at the moment of some of the great calamities has been established; whenever the barometer is low, I am always myself apprehensive of danger. The mercury is said to have been 29¼ inches at Swansea on the day of the Cethin catastrophe, and this may be considered a point low enough to excite anxiety, and induce extra care and caution in any pit where the coal is known to exude carburetted hydrogen gas." Although the evidence thus went on to prove that the ventilation of the pit was weak and ill-arranged, and also that there had been certain distinct breaches of general rules, yet it is doubtful whether the failure was of such a nature as to justify the verdict of the jury. It seems out of the question to suppose that a conviction for manslaughter will result from such evidence; and the matter may be expected to end, as many similar inquest verdicts do, in a matter-of-course acquittal at the assizes.

A live frog is alleged to have been found at the Tyr Nicholas Colliery, near Newport, on March 10, in the rock vein coal, 200 yards below surface. Mr. John Russell, the manager of the colliery, vouches for the fact, and proposes sending the block of coal, in which the frog was found, to the Great Exhibition. According to the latest accounts, it was alive and active.

The iron trade of this district has recently shown unmistakable signs of improvement. This is mainly attributed to the favourable operations of the

French tariff, and especially to the concessions which have recently been granted in reference to the importation of iron into France. Since the commencement of the American war, our ironmasters have been hard at work in trying to open new markets for the precious hardware, and it must be admitted with gratification that they have succeeded to a great extent, France, Italy, Spain, and other continental countries, having sent hither their orders; and large shipments are now being made to Toulon, Alicante, Leghorn, Barcelona, Naples, &c. The Tredegar Iron Company have a contract in hand for the supply of 10,000 tons of rails, which are required for the construction of the Italian railways. The Ebbw Vale, Beaufort, Pontypool, and Blaina Companies, are also better stocked with orders than has been the case for many months past. Of the five furnaces at Ebbw Vale, two are now lit; but there are evident signs of another being soon put in blast. Two out of the five are also lit at Victoria; and at Beaufort, four out of the nine furnaces. The coal trade may be said to be in *status quo*, neither improving nor more depressed. Although the home coal market is in a deplorable condition, yet the coasting trade of Newport has but slightly felt the effects of it. The wharves on the river side, where nearly all the coasters load, are fully occupied, and the fair wind which has set in for the last few days has enabled a great many vessels to leave the port for their respective destinations. Freights are moderate, and the complaints which were made of the scarcity of tonnage are gradually disappearing.

MERIONETHSHIRE.—Probably the most striking feature of the day in the mining world is the progress of gold-mining in Wales. The success of the Clogau Company seems to have revived, to some extent, the mania of 1853, although it is to be hoped that the experience then gained will induce a very different system of working. That gold occurs in Wales in remunerative quantities is now an established fact; and it seems also clear that a large portion of Merionethshire has all the geological characteristics of an auriferous country. For our own part, we do not doubt but that, carefully and properly worked, other prizes may be found in the district as well as Clogau. But the effect of gold in exciting the public mind seems to be something quite marvellous; and if Merionethshire mining is approached in that spirit, it requires no prophet to fortell numerous failures. Still every thing is liable to be abused; and because the gold district of North Wales is likely to be made a means of reckless speculation, that is no reason why its intrinsic importance should be overlooked. Among the new concerns started in this district is East Clogau, the shares of which are said to have been taken up readily by the public. Other concerns in the district are being worked by companies from the north, and among these some of the best-known localities for the production of splendid specimens of auriferous quartz, and which are undoubtedly fair speculations. One or two concerns, also, are about being brought out in the London market, supported by good reports and respectable names; and, if the public does not change its mind pretty rapidly, we may expect that they will readily succeed in procuring their capital.

CHESHIRE.—During the month of February the total export of white salt from Liverpool and Birkenhead was 40,748 tons, against 66,869 tons in the corresponding month of last year. The countries to which the exports were: United States, 7854 tons; British America, 3744 tons; South America, 22 tons; Calcutta, 20,684 tons; Baltic and North of Europe, 1338 tons; Australia, 769 tons; West Indies and Africa, 2680 tons; and France and the Mediterranean, 185 tons; the remaining 3512 tons were sent coastwise. The exports of rock salt from Liverpool and Birkenhead to all parts were 2204 tons. From Runcorn the exports were: white salt, 6930 tons; rock salt, 1280 tons.

NORTHERN COUNTIES.

NORTHUMBERLAND AND DURHAM.—The prodigal munificence with which the public subscribed to the Hartley Relief Fund has become a source of embarrassment, and may end in serious difficulties. At a recent meeting at Newcastle, the treasurer, Mr. W. Woods, reported that £54,022 was the amount in his hands; in addition to which there was a sum of £18,000 in the hands of the Lord Mayor, and a further sum of £262 to be received, making upwards of £72,000. Of this amount the Finance Committee have recommended the investment of £60,000 in the debentures of North Eastern and Newcastle and Carlisle Railway Companies, and the Tyne Improvement Fund, at rates that will produce £2500 a year interest. The £12,000 remaining will be left in the hands of the treasurer, or invested in securities readily available, to meet current payments. The following five gentlemen were named as trustees of the fund: Sir W. G. Armstrong, Messrs. John Clayton, R. B. Sanderson, jun., Hugh Taylor, and T. E. Forster. The application of this surplus fund is the great question to be decided. It has been proposed by the Committee that it should be applied to the formation of a permanent fund for the counties of Northumberland and Durham; but this is objected to by some, who are, however, willing that the surplus be applied for the foundation of a fund which shall embrace the nation at large. At the last meeting of the general Committee, however, a resolution was passed disclaiming any desire to deal with the funds except according to the wishes of the subscribers. No doubt the proposition to organise a permanent fund for the counties of Northumberland and Durham is a practicable scheme; while an attempt to establish such an organisation for the whole kingdom would probably fail, however desirable it might be to see it accomplished. Mr. Joseph W. Pease, of Darlington, has addressed a letter to Mr. Hugh Taylor, chairman of the Northern Coal Trade, containing suggestions as to the establishment of a Miners' Permanent Relief Fund. The *Newcastle Daily Chronicle*, speaking of the coal trade of this district, says it has been worse this year than for the last sixteen years. For household and manufacturing coals the demand has been especially bad. After paying freight and expenses in London, some manufacturing coals lately sent to London from the Tyne have not left two shillings as their price per ton at Shields! Of course at such a price they could not be produced. Bad though this is, the position of some of the London contractors for inland coals is even worse. We hear of fields having been taking in the neighbourhood of the metropolis for storing the coals coming from the midland counties that cannot be sold. The coal agents having bound themselves to take a certain quantity of coals, they are compelled to take them, and, not being able to sell them, they have to be put out in fields in the suburbs, to the great loss, no doubt, of the purchasers.

SCOTLAND.

THE SCOTCH IRON TRADE.—The stock of pig-iron has, during the last two months, increased upwards of 30,000 tons, and is now not less than 630,000 tons, inclusive of Carron. The market remains dull and stagnant; merchants, shippers, and consumers are not encouraged to extend operations beyond the immediate requirements of the home and foreign markets. The effect of he recent prostration of commerce is fully illustrated by the Board of Trade Returns, just issued; and it is futile to anticipate a return of prosperity until some time after the American struggle shall have terminated. The price of mixed numbers, warrants, is to-day 49*s*. 3*d*., against 48*s*. 3*d*. twelve months ago. No. 1 makers' iron, nominally 48*s*. 3*d*.; No. 3, 47*s*. 3*d*. per ton, free on board.

Mr. Ferrie, manager of the Monkland Iron Company, has been appointed the Government Inspector of coal mines in the East Scotland district, vacant by the decease of Mr. R. Williams. Among the candidates were Mr. Ralph Moore, Mr Mark Fryar, and Mr. R. H. Wynne, of Hulton Colliery, Manchester. It is stated that nearly every mine-owner in the eastern district recommended some person to the Secretary of State as fit for the office!

Metallic mining seems to be attracting considerable attention in Scotland. Lochwinnoch Consols Copper Mine, which is now under the management of a respectable Cornish agent, Captain George, is making a regular appearance in the ticketing list, and seems likely to prove a substantial concern. A mine adjoining—the Calder Glen United Mines—also under the management of a Cornish agent, Captain Bailey, seems to be likewise promising. The Lochwinnoch has hitherto only been worked by adit levels; but now a steam-engine is in course of erection, and a shaft, which is already down nine fathoms, will be sunk to the twenty. The ore is grey copper, producing from two to eight ounces of silver to the ton; and the proprietors talk of treating the ore by Longmaid's or Henderson's process, not being satisfied with the price they get from the smelters; they have 1000 tons of poor ores now available at the surface. The Calder Glen is apparently on the same lodes as Lochwinnoch; but the ground is lower, and the ore is yellow; they are also sinking here, and preparing for a steam-engine. Indeed there seems to be quite an enthusiasm for mining arising in Glasgow and its neighbourhood, about which several lead and copper mines are being started. Smelting works are also being erected at Glasgow. We hope on future occasions to be in a position to give more details on the progress of Scotland in metallic mining; looking generally at its geological features, there appears to be no reason why it should not prove a productive country.

IRELAND.

The gold excitement seems to be extending from Wales across the Channel, and the shares in the Carysfort Mining Company have recently risen rapidly in price in consequence. There can be no doubt that this property, lying round the foot of Croghan Kinshella mountain, is a gold district. As a matter of fact, it has produced more gold than any other part of the United Kingdom, including Merionethshire. It was worked by the Government in the latter part of the last century, and their operations left a profit on the washing of the alluvial sands. This profit was certainly ultimately more than lost in mining explorations for auriferous veins, which were never met with; indeed it is remarkable that in Wicklow not a speck of gold has ever been found *in situ* in a lode, notwithstanding that the alluvial gold was so comparatively abundant.

The proposed amalgamation of the Wicklow Mine Company (Ballymurtagh Mine) with the old Hibernian Mining Company has been referred to a committee. This committee has not yet made its report; and there seem to be certain legal difficulties in the way, which may probably prevent the proposed amalgamation being carried, if it should be distasteful to any considerable proportion of the shareholders. There can be little doubt that the amalgamation would be beneficial to the concern.

METALLURGY.

An improved process of introducing fuel into blast-furnaces, invented by Mr. John Broad, of Handsworth, has been applied at the Park End Works, Forest of Dean, Gloucestershire, where the result is said to be favourable, much of the small fuel now wasted being utilised, and made nearly as valuable in the blast-furnace as the large coke and raw coal.

Mr. A. Parkes, of Birmingham, proposes to improve the quality of yellow metal sheathing, by adding ½ to 2 per cent of tin or aluminum thereto.

THE SPELTER TRADE.—Messrs. Berger report, that since our last this metal has been subjected to many variations: without any immediate cause or reason prices from 18*l.* receded to 17*l.* 5*s.* and 17*l.* 10*s.*; but at this reduction they stopped, and our previous remarks that the stocks in the principal markets are not above the average, were fully proved during the last fortnight, when a sudden rise of 10*s.* up to 25*s.* was immediately established in Hambro' and Breslau by large purchases, made principally for France, where the stocks are very low. Our market followed, and about 1500 tons were done at 18*l.* to 18*l.* 10*s.* spot, 18*l.* 10*s.* delivery; but prices abroad are still above ours, and it is not unlikely that continental buyers will have to come and buy from us very shortly. We also must expect some demand from India, whence the shipments have been very small for some time.

Stocks on March 1, 1862	.....5123 tons;	price from £17 10	to	£17 15
,, 1861	4087	,, 18 0	,,	18 5
,, 1860	3264	,, 20 15	,,	21 0
,, 1859	3979	,, 21 5	,,	21 10
,, 1858	1673	,, 26 0	,,	26 10

THE MINES ROYAL COPPER-SMELTING WORKS.—These works, situated at Neath, are now in the market. The lease expired on the 25th March, and the Mines Royal Company have declined to renew on the terms sought to be imposed by the landlord, who insisted on introducing a clause into the new lease, compelling them to consume 24,000 tons of coal per annum. This clause was proposed for the purpose of bettering the coal proprietors on the estate, who supply the works with coal, and whose lease has been renewed with such a clause in it. Efforts are now being made to get another company to take them, subject to this condition; but as yet without success. Negotiations are at present pending with a party in London. The works are in good order, and comprise, 4 ore calciners, 7 ore furnaces, 2 metal calciners, 5 metal furnaces, 2 roasting furnaces, and 1 refining furnace,—all new and ready to put the fires in, with room in the buildings for 25 furnaces more, and quite sufficient for the smelting and refining of from 50 to 60 tons of copper weekly. There is water for vessels of 150 to 200 tons. Canal to Swansea, rail within 1¼ miles, and another line (narrow guage), to be made this year, passing within 150 yards of the works, with which it will be connected by a siding. This latter line will open a direct communication with the whole midland system. The works altogether are undoubtedly most desirable, from their general suitability and compactness; the only objection is the coal-clause above referred to.

Mr. F. Fowler Bankhart, late of the Britton Ferry Copper Company, has been appointed manager of the smelting operations of the Cobre Mining Association, who have determined to smelt their poorer ores in Cuba.

FOREIGN AND COLONIAL.

While home mining is languishing from want of support, the tendency to invest in any foreign scheme seems to be reaching almost the proportions

of a mania. Gold seems particularly in the ascendant abroad as well as at home; and particularly the great success of St. John del Rey has drawn up a host of neighbours. These may be fair speculations enough; but it is quite clear the public are equally prepared to rush into concerns which afford no guarantee either as to the character of the ground itself or of those connected with the speculation. Foreign mining, in good hands, has had some splendid successes; but it has also been the means of causing terrible losses, and will be so again if approached in the spirit which now seems dominant. The present generation seem to have forgotten the great losses of the last generation in foreign mines; but if they are not cautious, they will soon learn it to their own cost.

NEW SOUTH WALES.—By the arrival of the Australian mail we have news from the coal-field of New South Wales down to the middle of January. The most important items of intelligence are subjoined:—

The *Maryborough Chronicle* reports that a seam of coal has just been discovered about eighty miles or so from Port Denison. It is said that the quality is most excellent, and that there is abundance of the article. Copper ore has also been found in the same locality, and there is now no doubt whatever but that the whole district abounds in mines, chiefly copper. Capital is required to work it out.—The *Newcastle Chronicle*, published in the Hunter River district, announces that a very fine seam of coal has been found about a mile and a half from New Chum's Flat, towards the Waitahuna. It is found about six feet below the surface, and it is said to be the best coal yet found in the Province. The seam is about three feet through.

The *Queensland Times*, in an article on the history and progress of Queensland since its separation, has the following:—Perhaps the next in importance to that of our pastoral resources are those of our mines. Of coals we have an illimitable supply, the principal pit in operation at the present time being that of Redbank, about eight miles from Ipswich, near the junction of the Bremer and Brisbane rivers. The owners of the mine, Messrs. Campbell and Son, have for some time past been supplying the Australasian Steam Navigation Company with the coal required for the use of the steamers plying between Sydney and Brisbane, and between Brisbane and the northern ports. Besides this, a considerable portion of the coal consumed in the towns of Brisbane and Ipswich is supplied from this mine. The proprietors have lately sunk a second shaft to a bed of superior coal very similar in character and appearance to the cannel coal of the north of England. The Maggill Pit, on the Brisbane River, has been closed for some months through the failure of the lessee. The pits of Messrs. Walter Gray and Co. at Cluman, near Ipswich, are being re-opened, in anticipation of an extended trade. We see by the last mail from England, that the *Times* congratulates the Peninsular and Oriental Steam Navigation Company, and other great companies, on the fact that coal has been discovered in Tasmania, and that, therefore, a great saving may be effected by the use of that coal in the event of the companies adopting it in preference to English, which they are compelled to send out by sailing vessels at great expense; and in the event of new steam routes being adopted, Tasmania is pointed out as an excellent depôt from whence to obtain coal. We trust that the day is not far distant when we shall possess a line of steamers through Torres' Straits; and when we do so, we shall be able to supply them with excellent coal, without their going so far out of the way to obtain it as to Tasmania; and what is of equal importance, we can supply it at a cheap rate too.

The following statement shows the quantity of coal exported from Minmi during the year 1861. It will be observed, that from August 24th to October 19th, only 1326 tons were exported, and they were despatched during the week previous to the 19th. The eight weeks of the strike are included in that period:

					Tons.	cwt.	qrs.
Fortnight	ending	January	12	....	2085	15	0
„	„	„	26	....	3383	19	0
„	„	February	9	....	2186	3	0
„	„	„	23	....	1536	15	0
„	„	March	9	....	3552	10	0
„	„	„	23	....	3443	15	0
„	„	April	6	....	3386	5	0
„	„	„	20	....	3702	10	0
„	„	May	4	....	2642	13	0
„	„	„	18	....	2664	18	0
„	„	June	1	....	2098	15	0
„	„	„	15	....	3935	2	0
„	„	„	22	....	3528	6	0
„	„	July	13	....	3020	6	0
„	„	„	27	....	2222	6	0
„	„	August	10	....	2196	2	0
„	„	„	24	....	1438	3	0
„	„	October	19	....	1326	0	0
„	„	November	2	....	2251	2	0
„	„	„	16	....	998	0	0
„	„	„	30	....	1641	10	0
„	„	December	14	....	3073	10	3
„	„	„	28	....	2546	18	3
„	„	„	31	....	227	15	0
			Total	....	59,089	6	2

At the sitting of the Legislative Assembly, on the 31st December, Mr. Lewis obtained leave to introduce a bill for the better regulation of coal-fields and collieries. On the Friday following, namely on the 3d of January, Mr. Lewis moved the second reading, which was carried after considerable discussion. The bill having been read a second time, Mr. Lewis consented to let it lapse for the present.

NEW BRUNSWICK.—In the British Province of New Brunswick in 1851 the product of the coal-mines was 2842 tons; in 1861 the coal product was 18,244 tons.

CANADA.—The *Detroit Free Press* has the following on the coal-oil trade. About three hundred wells are sunk and in progress at Enniskillin, Canada West; and the monstrous flowing well, which we noticed a few days ago, is said to be capable of yielding oil sufficient to load a four-hundred-ton vessel daily. This flow has been curtailed by tubbing, so that the daily yield now is only about six or seven hundred barrels, which are being taken care of. Other wells, as good or better, will doubtless be opened in this locality, and the supply of oil will be limitless. These wells are only about fifty miles from this city, not far from the line of the Grand Trunk Railway, and approachable to within fourteen miles by the largest lake-boats. The crude material must find a market for manufacture here. Already many Michigan capitalists have invested in claims in the oil region. About 300,000 dollars have been expended in digging wells, erecting refineries, opening roads, &c. There are already half a dozen oil refineries in this State, and some of them on a very extensive scale. Others will be erected as the occasion may require, and this branch of manufacture may yet prove the most important in our city or State. The coming spring will doubtless witness great activity both in manufacture and shipment. Letters have been received from England and Scotland, which indicate that the market is to be very great, and the demand will possibly be greater than the supply can fill.

Metal Markets.

The following weekly reports from Messrs. Von Dadelszen and North, show the position of the metal market during the month.

March 5.—Business in metals has been very quiet. The downward tendency of copper and spelter has been followed by an actual decline in price; operators still use the greatest caution in their purchases.

Copper was officially reduced on the 1st inst., ½d. per lb. for manufactured, and 4*l*. 10*s*. for tile and ingot; but the market is still very unsettled, and purchases can be made at 10¼d. per lb. Foreign is dull and lower. We quote Burra Kapunda 95*l*. and Chili 86*l*. to 87*l*.

Tin has kept its position very well; Straits 117*l*. to 117*l*. 10*s*. cash, and 118*l*. to 118*l*. 10s., 3 months open. A small parcel of Banca sold yesterday at 125*l*. English unaltered. The Dutch market quiet, at 74f. to ½.

Tin Plates quiet but steady, at previous quotations.

Lead is extremely dull.

Spelter is lower; sellers on the spot at 17*l*. 10*s*., and no demand for forward delivery.

March 12.—We do not see as yet any signs of an improved demand for metals. The business done since our last report hardly calls for any remark, and the cheapness of money does not encourage speculators in the face of the low prices now ruling.

Iron.—Welsh bars sell very slowly, at 5*l*. to 5*l*. 2*s*. 6*d*. f.o.b. Wales, and from 5*l*. 15*s*. to 6*l*. here. Staffordshire iron remains very dull. A steady business has been done in Scotch pig iron, closing firm at 49*s*. 3*d*. cash, and 50*s*. three months open.

Copper was very dull until yesterday, English manufacturers selling at 10¼, and tough cake and ingot 93*l*.; now the market is firm; 10½d. asked. Business in Burra has been reported at 95*l*., but few sellers now thereat; Kapunda, 96*l*.; Chili, 86*l*.

Tin quiet, but steady. English unaltered. Straits 117*l*. cash and 118*l*., three months prompt. Banca, 125*l*. nominal. The Dutch market has declined to 74f.

Tin Plates.—The demand has fallen off, but prices are unaltered.

Lead.—But little business doing, with a dull market.

Spelter.—On Monday 100 tons were done at 17*l*. 5*s*., since which the market has assumed a firmer tone; yesterday about 250 tons changed hands at 17*l*. 10*s*. spot and for forward delivery, at 17*l*. 15*s*. Hull parcels realised 17*l*. 10*s*.; W. H. 18*l*. 5*s*.

March 19.—There has been an improved demand for some kinds of metals accompanied with a slight advance in value, whilst others have been very quiet with a drooping tendency.

Copper.—The demand for manufactured having improved, the smelters now adhere to fixed prices, but secondhand lots can be bought a trifle under. Foreign has slightly improved; 96*l*. paid for Burra, and 97*l*. now asked. Kapunda 97*l*. For Chili 87*l*. has been offered and refused.

Tin remains dull of sale. We quote Straits 117*l*. cash and 118*l*.—three months prompt. Banca nominally 125*l*. The Dutch market is dull at 74f. sellers. English unaltered.

Tin Plates.—The manufacturers are completing old contracts; the demand is slack and prices unaltered.

Lead remains in a languid state.

Spelter has improved, and a fair amount of business has been done on the spot at 17*l*. 17*s*. 6*d*., 18*l*., and 18*l*. 10*s*., now asked 18*l*. 5*s*., offered. 100 tons, April delivery, were done yesterday at 18*l*. Hull parcel, 17*l*. 15*s*. 0*d*., 17*l*. 17*s*. 6*d*., W. H. 18*l*. 15*s*.

March 26.—The firmness which we reported in our last circular in some branches of the metal trade, has been well maintained; there is, however, an absence of a general demand.

IRON.—Welsh bars move off slowly, 5*l.* the price f.o.b. in Wales, and from 5*l.* 17*s.* 6*d.* to 6*l.* here (f.o.b.). The demand for Staffordshire iron is slowly increasing. Scotch pig iron has advanced to 50*s.* 3*d.* cash, with a further upward tendency.

COPPER.—English descriptions have stiffened in value, though sales a trifle under official quotations for manufacturers have taken place to a fair extent during the last few days. Tough cake and ingots, 95*l.* to 96*l.* For Burra 97*l.* has been paid, and now 98*l.* asked. Kapunda 98*l.* nominally. Spanish 90*l.* Chili in Liverpool, 89*l.* to 90*l.*

TIN quiet, with but little doing. Straits, 117*l.* Banca, 125*l.* nominally. The Dutch market dull at 74f. English unaltered.

TIN PLATES.—The demand has fallen off, but prices are fairly maintained.

LEAD is very dull; good soft English from 19*l.* 10*s.* to 19*l.* 15*s.*

SPELTER.—A large business has been done, both on the spot and for spring shipment. We estimate this week's transactions at about 1500 tons from 18*l.* 7*s.* 6*d.* to 18*l.* 12*s.* 6*d.*, and there is every appearance of higher prices being paid before long, 18*l.* 10*s.* spot the closing price.

Metallic-Ore Markets.

TIN.—The decline in the standards for black tin still continues. In the early part of the month the standard was put down 2*l.* per ton, making the rates:—

Refined	£109.
Common	105.

In the middle of the month a further decline of 2*l.* was announced, making the present rates:—

Refined	£104 to 107.
Common	103.

On this the *West Briton* remarks:—"This continued decline in price makes a serious difference to our tin mines—the drop during the last two years being about 29*l.* per ton on Refined, and on Common, 26*l.* The present price leaves a margin between the quoted price of metal and black tin in favour of the smelters of 17*l.* per ton."

COPPER.—At the four Cornish sales we give this month, the average produce, price per ton, and standard, have been as follows:—

	Produce.	*Price per ton.*	*Standard.*
Feb. 27	$6\frac{1}{4}$	5*l.* 1*s.* 0*d.*	125*l.* 0*s.* 0*d.*
Mar. 6	$6\frac{7}{8}$	5*l.* 13*s.* 6*d.*	123*l.* 9*s.* 0*d.*
„ 13	$6\frac{3}{4}$	5*l.* 13*s.* 0*d.*	124*l.* 12*s.* 0*d.*
„ 20	$5\frac{3}{8}$	4*l.* 14*s.* 0*d.*	129*l.* 12*s.* 0*d.*

Compared with the previous sale (Feb. 20), at the sale of the 27th February there was, according to the *Mining Joarnal*, a decline in the standard of 2*l.* 8*s.*, while according to the *West Briton* there was an advance of 2*l.* At the next sale, March 6, there was an advance of 1*l.* according to the *Mining Journal*, but of only 18*s.* according to the *West Briton*. At the sale of March 13th, there was another advance of 12*s.* 6*d.* or 14*s.* 6*d.*, according as we accept the authority of one of the papers

named or the other. At the sale of the 20th, the standard was stationary according to the *West Briton*, while if we take the figures of the *Mining Journal*, there was a decline of 1*l*. It must be quite understood, that, in referring to these discrepancies, we have no intention of reflecting on the knowledge or accuracy of either of the papers referred to. Our purpose is merely to show, as we pointed out in our first number, that at present the "standard" has little or no meaning, and instead of showing at a glance how the price of ores has gone, really tends to confuse the subject. That the persons most intimately acquainted with it—as those who make the calculations in the papers referred to undoubtedly are—differ so frequently in their estimates, is the best proof that there is really no sound data to go upon under the present system.

LEAD.—Comparing the sales of Lead Ore for the month with those of the former month, there appears to be no material alteration in prices.

London Share Market.

THE Mining Market during the month has shown a great improvement as compared with the past few months; the abundance of money, the buoyancy of prices, and above all, the very favourable progress made towards eventual success in one or two instances, have, combined, imparted a tone of confidence to the investing public, the absence of which for so long a period has been almost a matter of wonder to many of the dealers and brokers. It is with the greatest pleasure, therefore, that we hail this revival of business; for if our numerous copper and tin mines can by their own intrinsic value or merit command the attention of the public, and moreover of the practical agents in various parts of Devon and Cornwall, as a source for investing and employing their spare capital, at a period like the present when the metal market remains in so unencouraging a condition, how much more valuable will these properties become when the exports of metal again reach their former amounts. Hence the satisfaction felt at the more cheering prospects of the past month.

The American dispute has been quoted from day to day and week to week, as the main cause of the depression in trade generally, and a glance at the government returns will at once prove the correctness of these assertions. We therefore, for this, and many other reasons, heartily echo the wishes expressed by many for the early solution and termination of the dispute, and the resumption of commercial and friendly intercourse.

Referring to districts, we find that Liskeard mines continue to receive the greatest favour from the public, and East Caradon has reached the highest price this month of any yet attained by this successful adventure. South Caradon, Marke Valley, West Rose Down, too, have received considerable attention. Further west we find East Carn Brea has made considerable progress, and bids fair soon to become a dividend mine. Great Fortune, Cook's Kitchen, have also advanced in price, and have been largely bought up by influential investors.

The following will give the summary of the month's business.

Alfred Consols have been freely offered for sale at much lower prices. The further outlay required for the working of the mine seems to be the cause of this depression.

Carn Camborne occasionally in demand, but scarcely any variation in the quotations.

Clifford Amalgamated continue rather dull at 29-31.

Camborne Vean have declined to 1⅜-⅝., and only a very few transactions.

Cook's Kitchen largely in request, and have improved to 33 buyers; the accounts of the prospects of this mine continue of a highly satisfactory character.

Devon Great Consols have changed hands at 412½, the dividend declared at the meeting held on the 27th ult. was £8 per share.

East Basset very quiet and inactive at 43-45.

East Caradon have fluctuated greatly, and close 33¼-½, having touched 34¼; the lodes in this mine continue to open out well and productive.

East Carn Brea, after having advanced to 13¼, close rather lower, viz. 12⅛-¾.

East Grenville have been rather largely dealt in, but close a shade easier.

Great Fortune have been in great favour during the past few days and have advanced to 20, the late improvement in the mine having caused a demand for these shares, large numbers of shares have changed hands, and the prospects of the mine at present are very good indeed.

Herodsfoot: not much business doing, 36-7.

Hingston Down a trifle firmer, 2⅜-½.

Marke Valley have been more offered during the month, and close a little flatter, 9⅞-10; the next dividend is expected to be 5*s*. per share.

North Downs fluctuating, they close 4⅝-⅞.

North Basset: a little more inquiry at 3-½.

North Treskerby steady at 19-20.

Providence more in demand, they close 41½-2½.

Rosewall Hill have declined to 3⅜-⅝.

South Tolgus: occasional dealings at 54-56.

South Caradon very firm at 327½-32½; a dividend of £5 was declared at the meeting held on the 27th ult.

South Frances became in request and rose to 107½ buyers, they subsequently receded, and close 102½-7½.

Stray Park: a little more activity at 30-31.

Tincroft not so firm, more shares offering, 9⅞-10⅛.

Tamar Silver Lead remain nominally, 28*s*.-30*s*.

West Caradon steady and quiet at 40-41.

There have been some inquiries for West Frances, they are quoted 10-12.

West Rose Down not quite so firm at the close, 13-15.

West Polmear, after receding to 2*s*. 6*d*. to 3*s*. 6*d*., suddenly advanced to 7*s*. 6*d*. to 10*s*.; they close, however, 6*s*. to 8*s*.

West Seton 272½-7½, and firm at this price.

Wheal Basset quiet at 99-101.

Wheal Grylls have improved to 17-18, owing to a good report from the mine.

Wheal Harriett have suddenly risen to 25*s.* on a discovery reported on Thursday last.

Wheal Grenville is much improved during the month, the price remains steady at present at 52*s.*-54*s.*

Wheal Uny again in demand at 5¾.

Wheal Ludcott: many buyers towards the close of the month at higher prices.

Wheal Margaret quiet but firm at 44-46.

Wheal Seton, after remaining steady at 121-3 for some days, quickly advanced to 129 buyers; they close 126-128.

West Tolgus much sought after.

Tolvadden have been dealt in to a large number of shares at 3-½.

Trencrom inquired for, 3¼-¾.

New Seton very quiet at 55-60.

North Crofty, 36*s.*-38*s.*

Great South Tolgus: sellers predominate, 3-¼.

Wheal Trelawney 17-18, occasional transactions.

Craddock Moor have been dealt in at 29-31.

Bryn Gwiog has improved lately, and the shares are now firm.

In Foreign mines there has been a large amount of business done, more particularly in Scottish Australian, St. John del Rey, United Mexican, Port Phillip, and Great Northern Copper.

St. John del Rey have receded, and close 58-60.

United Mexican have also declined to 7¼-½, at which they close.

Port Phillip ⅞-1, being a shade firmer than for the last few days.

In other Foreign mines not much variation to notice.

Thursday, 3d April, 1862. 2.30 P.M.

The following are the closing prices :—

For the last few days the Markets have been scarcely so active, speculation being almost wholly confined to the new loans, banks, &c., recently brought before the public; the quotations of mines have, however, generally been firm.

Carn Camborne, 12/ to 14/; Camborne Vean, 1¼ to ½; Cook's Kitchen, 34½ to 5½; Devon Great Consols, 400 to 5 ex div.; East Basset, 43 to 45; East Caradon, 34¼ to ½; East Carn Brea, 12⅝ to ¾; Great Fortune, 20 to ¼; Herodsfoot, 36½ to 7½; Hingston Down, 2⅜ to ½; Marke Valley, 9⅝ to ⅞; North Downs, 4½ to ¾; North Basset, 3 to ½; North Treskerby, 21 to 22; Providence, 41 to 42; Rosewall Hill, 3¼ to ½ ex div.; Rosewarne United, 21 to 23; South Caradon, 330 to 32½; South Frances, 97½ to 102½: Stray Park, 29 to 31; Tincroft, 9⅞ to 10⅛; West Frances, 10 to 11; West Rose Down, 11 to 13; West Seton, 270 to 75; Wheal Grylls, 27 to 9; Wheal Harriett, 25/ to 7/; Wheal Grenville, 57/ to 59/; Wheal Uny, 7 to ¼; Wheal Ludcott, 4⅛ to ¼; Wheal Margaret, 44 to 46; Wheal Polmear, 16 to 18; Wheal Seton, 128 to 30.

Provincial Share Market.

DUBLIN.—The following report is condensed from the *Mining Journal*:—At the close of the last month considerable fluctuations took place in the shares of the Mining Company of Ireland, which from £17. 10*s*. per share were at one time in demand at £18. 17*s*. 6*d*. This was not sustained, but at £18. 10*s*. cash, and £18. 15*s*. for account, they leave off in fair request, making an advance of £1. to £1. 5*s*. General Mining Company for Ireland shares were weak at £5., so were Connorree shares at 29*s*. 6*d*., and Carysfort shares have not moved, remaining nominally quoted at 9*s*. Wicklow Copper Mining Company shares have receded from £2. to £3. per share, in consequence of the present unsettled state of their position pending the consideration of the desirability of an amalgamation with the Hibernian Mining Company, recommended by the directors: the shares were on sale at £51., being a fall of £2.

In the early part of March large aud numerous transactions took place in the shares of the Mining Company of Ireland and of the Wicklow Copper Mining Company; the former rose to 19*l*. and 19*l*. 5*s*. for account, and continued in demand at a trifling reduction on that price —at 19*l*. or 19*l*. 2*s* 6*d*. for account, or an advance of 10*s*. per share. Wicklow Copper shares fell further to 50*l*. each, at which price they were firm when the committee of investigation and the directors of the company met for the first time. Later on they rose to 52*l*. to 53*l*. 15*s*., and to 54*l*. buyers, sellers at 54*l*. 5*s*., or an advance of 3*l*. 5*s*. per share. A desire to realise, however, brought them down again to 53*l*. Connorree shares found buyers at 29*s*.; Carysfort shares nominally quoted at 8*s*. 6*d*. to 9*s*.; but General Mining Company for Ireland shares would not be taken except at a great reduction.

Towards the middle of the month, Wicklow Copper Mining Company shares, which a fortnight before were procured in large numbers at 50*l*., and then rose to 54*l*., buyers, receded to 51*l*. The Mining Company of Ireland shares fell to 18*l*. 12*s*. 6*d*., and again rose to 19*l*., at which price they were freely taken. Carysfort shares changed hands at 9*s*. 6*d*. each. General Mining Company for Ireland shares unusually weak, 4*l*. 10*s*. only being offered for them, although ineffectually. Connorree shares on sale at 30*s*. to 30*s*. 6*d*. each.

Further on in the month Mining shares were in considerable favour, with a steady tendency to improvement in prices. Wicklow Copper shares, which had been at 51*l*. sellers, exchanged hands at 50*l*. 10*s*., but all that offered at 50*l*. 15*s*. were readily taken, sellers demanding 51*l*. The shares of the Mining Company of Ireland particularly steady, with an improvement of 5*s*. on last price, or at 19*l*. 5*s*. for cash, and 19*l*. 7*s*. 6*d*. for next account. Carysfort shares, which had been procurable at 9*s*. 6*d*., gradually rose to 11*s*., 11*s*. 6*d*., and 12*s*., and some of the free shares of this company, fully (at 2*l*. 10*s*. per share) paid up, sold at 1*l*. 5*s*. and 1*l*. 7*s*. 6*d*. per share, or at a discount of 50 per cent. Connorree shares changed hands at 32*s*. In General Mining Company for Ireland shares no business done.

EXTRACTS FROM MINING CIRCULARS.

From MESSRS. WEBB AND GEACH, 8 *Finch Lane, London.*

THE markets have been very active throughout the week, and buying orders predominate. Some of the good tin mines have come into great request in consequence of good improvements. The most extraordinary advance has been in Great Fortune, which, on Monday, at once rose 2*l.* per share, and has maintained the price; these shares have now, in a few months, risen from 12*l.* to 20*l.* The 78 east of Painter's Shaft is said to be a splendid course of tin. There has also been a good demand for Tolvaddens, although the price has fluctuated most considerably from 3*l.* to 4*l.* 5*s.* Cook's Kitchen have been in extraordinary request, with shares very scarce, though the price has advanced to 33 buyers. Devon Great Consols, 410-15, and quiet. East Bassets continue very flat under pressure of sales, and are quoted 43-45. East Caradons continue to fluctuate very considerably, with a very little change in the value of the mine. They have been as high as 34¼ buyers, and are to-day 33¼-⅝, and flat. The report from the mine on the 24th was as follows:—"50 east not so good, now worth 60*l.* per fathom; 61 east worth 55*l.* per fathom. *New Lode:* 60 west worth 20*l.* per fathom; 60 east worth 12*l.* per fathom. *Fawcett's Lode:* 60 east worth 12*l.* per fathom." This mine is more freely dealt in on the market than any other.

From MESSRS. WATSON AND CUELL, 1 *St. Michael's Alley, Cornhill.*

The market has been without much variation since our last. East Carn Breas reached 13¾-13½, but became weaker on Monday, and leave off 12⅝-12⅞. East Caradons opened very firm at 34, but leave off 33-33½. From the report in another column, it will be seen that the 60 is not looking quite so well, but it is too much to expect that such a lode can continue without temporary fallings off. West Caradons have been more inquired for. Wheal Grenvilles have been in great request, and advanced to 3. The mine is daily improving, and may soon rival East Carn Brea. East Grenvilles are also better. West Trevelyans are at 2*l.*, buyers. Grambler and St. Aubyns not so firm. Great Wheal Fortunes have advanced to 20-21, and in good request. West Polmears in demand, at improved prices. Wheal Setons have advanced to 129-131. South Caradons in good request, at an advance. Providence Mines rather quiet. Rosewall Hill and Ransoms not so firm. Kitty (Lelant) up to 14-14½. Ludcotts up to 3½, and flatter again.

From MR. P. WATSON'S *Mining Circular.*

WHEAL GRYLLS.—Agent's report:—"Fisher's Lode: At Annie's engine-shaft we have commenced driving east and west at the 30 fms. level. In the end east the lode is worth 35*l.* per fm., and west 30*l.* per fm. At the 20 fms. level west the lode is producing a little tin, but not rich. The winze in the bottom of this level, east of the shaft, is suspended, by reason of so much water, but we expect it will be drained in a few days by the 30 fathoms level. The lode is worth 25*l.* per fathom. In the end east of the flat-rod shaft the lode is worth 7*l.* per fathom.—Georgia Lode: In the engine-shaft there has been no lode taken down since last reported on, but the wall is presenting a favourable appearance, and when last cut through it was worth 30*l.* per fathom. In the adit end north of the shaft the lode is a little improved, worth 50*l.* per fathom. In the rise in the back there is no alteration; the lode is worth 30*l.* per fathom. At the 33 fathoms level driving north the ground is in a disordered state, and is not yet got through the influence of the copper lode." From the above report it will be seen that the mine has further considerably improved, and that the deeper the mine is worked, the richer it is in every part. Shares 20*l.* to 21*l.*, and very scarce.

THE CORNISH MINE SHARE MARKET.

(From the *West Briton.*)

March 27.—There has been a very fair amount of business doing in the Mining Market, and prices are generally steady, with the exception of Great Fortune, which on a report of a good course of tin being cut in the 78, rose from 17 to 20, and continue firm. Uny have also advanced from 5 to 6; at the meeting on Monday there was a debit balance of 1940*l.*, and a call of 5*s.* per share was made (1024*l.*); the returns for the last quarter more than paid the costs, but a lot of new machinery was required, hence the call; in the next quarter good profits will be made. Cook's Kitchen in request, 31½-32½. Tincroft, 10½-11. Basset 97-99, and rather flat. At East Basset on Monday, a 2*l.* dividend was declared, but shares close rather flat at 41-42. North Treskerby, 19-19½; Tressidder's shaft reported looking well. South Tolgus 54, ex div. of 30s., declared on Tuesday. West Tolgus, 30-32. Margaret 45-46, and looking well. Providence, 42-3. At Rosewall Hill and Ransom, the first dividend of 3*s.* per share (300*l.*) was declared on Wednesday, leaving 350*l.* to the credit of the next account; a good report was read from the manager, Captain Treweeke, who said he considered the mine in a very thriving condition. Kitty Lelant, 14½-15½, much in demand and scarce; a 10*s.* div. is expected on Wednesday next. Trencrom 3½-¾, rather more than paying cost. Wheal Seton have advanced from 122-130, and close firm at 127-128. Botallack is looking remarkably well, and will, with a good price for tin, pay large dividends; they have also a considerable improvement in the copper part.

The Gwinear Mines are very flat. Rosewarne United as usual have receded from 33-35 to 22-24; this is very vexatious to those who were persuaded to buy on the late rise. At Rosewarne Consols meeting on Tuesday, the accounts showed a debit balance of 2*l.* 5*s.* Alfred Consols, with Great Alfred we fear, is likely to stop—a bad job for the district; the former shares 5*s.* call paid. East Alfred flat, 15*s.*-16*s.* Tolvadden reported improved. At Boscundle meeting on Tuesday, the accounts showed a debit balance of 900*l.*; a call was made of 10*s.* per share (1140*l.*).

At East Providence a call has been made of 2*s.* 6*d.* per share (512*l.*). Wheal Jane 17*l.* ex div.; tin in the stone has been sold for 996*l.*, and black tin, 124*l.*; this is one month's sale exclusive of lead or mundic, which will realise 500*l.* more. At Wheal Reeth meeting the debit balance was 3251*l.*, and the loss on the quarter's working, 1110*l.*; a call of 5*l.* per share was made. It is said the new Tin Smelting Company at Redruth are quite prepared to purchase ores at the present time, so that we may expect shortly to hear of their being active buyers.

At West Providence meeting on Monday, the accounts showed a debit balance of 1255*l.* to the end of January; it was resolved that all operations not absolutely necessary be suspended. At Trevenen and Tremenheere on Tuesday, a call of 3*s.* per share was made (840*l.*). At South Crofty on Monday the accounts showed a debit balance of 1084*l.*; a call was made of 1*l.* per share (937*l.*). At Nanjiles on Tuesday, a call of 30*s.* per share (1536*l.*). At Wheal Vivian a call of 20*s.* per share (512*l.*).

Prices Current of Metals.

			Per Ton.		
IRON	Bars	in Wales	£5 2 6	@	£5 5 0
	,,	,, Liverpool	....		5 15 0
	,,	,, London	6 0 0	,,	6 5 0
	Nail Rods	,, Wales	5 12 6	,,	5 15 0
	,,	,, Liverpool	6 10 0	,,	7 5 0
	,,	,, London	7 5 0	,,	7 15 0
	Hoops (Staffordshire)	,, Liverpool	7 15 0	,,	8 10 0
	,, ,,	,, London	8 5 0	,,	8 15 0
	Sheets ,,	,, Liverpool	8 10 0	,,	9 5 0
	,, ,,	,, London	9 0 0	,,	9 15 0
	Bars ,,	,, Liverpool	7 0 0	,,	8 0 0
	,, ,,	,, London	7 10 0	,,	8 10 0
	Scotch Pig (No.1.g.m.b.)	the Clyde	2 10 0	,,	2 10 6
	Rails	in Wales	5 5 0	,,	5 10 0
	Russian	C.C.N.D	....		...
	Swedish—Hammered—large sizes		11 10 0	,,	11 15 0
	,, ,, Indian sizes		11 10 0	,,	11 15 0
STEEL	Hammered—faggot		....	,,	16 10 0
	,, in kegs ½ and ⅝ in.		....	,,	15 10 0
COPPER	Australian and other *fine* Foreign		97 0 0	,,	98 0 0
	Foreign Slab, for Prod. 96 per Cent.		....	,,	88 0 0
	English Tile and Tough		95 0 0	,,	98 0 0
	,, Best selected		98 0 0	,,	101 0 0
			Per lb.		
	,, Sheets, Sheathing and Rod		10¾*d.*	,,	11*d.*
	,, Flat Bottoms		11¼*d.*	,,	11½*d.*
YELLOW METAL	Sheets, Sheathing and Rod		8½*d.*	,,	9*d.*
			Per Cwt.		
TIN English	Common Blocks and Ingots		....		120*s.*
	,, Bars (in barrels)		....		121*s.*
	Refined		....		122*s.*
Foreign	Straits		....		117*s.*
	Banca		....		125*s.*
			Per Box.		
TIN PLATES at Liverpool 6d. Less.	Charcoal IC		28*s.*	,,	29*s.*
	,, IX		34*s.*	,,	35*s.*
	Coke IC		22*s.*	,,	23*s.*
	,, IX		28*s.*	,,	29*s.*
			Per Ton.		
LEAD	Sheet		£21 0 0	,,	£21 5 0
	Pig—W.B.		21 0 0	,,	21 5 0
	,, ordinary brands		....		20 0 0
	,, Foreign, soft		....		19 10 0
	Red		....		22 0 0
	Shot		....		22 10 0
	Dry White		....		27 0 0
SPELTER	(Cake)		....		18 10 0
ZINC	(Sheet)		....		23 0 0
			Per Bottle.		
QUICKSILVER	(in bottles containing 75lbs. each)		....		7 0 0
			Per Ton.		
REGULUS OF ANTIMONY, French Star			....		47 0 0

Large sales of *Scotch Pig Iron* have been made this week, and the price has advanced about 1s. per ton.

In other articles there is no new feature to notice, prices being without change, but not much doing.

Copper Ores.

Sampled Feb. 12, and sold at Tabb's Hotel, Redruth, Feb. 27.

Mines.	Tons.	Purchasers.	Price.		
Great Wheal Busy	72	6	£1	17	6
	71	14	1	18	6
	68	6	3	0	0
	65	6	2	4	0
	64	6	2	16	0
	62	6,8,9	2	9	0
	61	10	2	5	6
	60	6	2	13	0
	46	6	3	8	6
	36	3	2	5	6
	34	6	2	0	6
	1	6	30	7	0
South Caradon............	103	8	5	19	6
	95	6	6	10	0
	76	6	9	2	6
	71	2,4,6	17	6	0
	51	8	8	16	0
	34	8	17	7	0
	32	6	6	13	0
Fowey Consols............	100	2,6	5	13	6
	92	2,6	6	4	6
	78	2,6	7	3	0
	75	2,6	7	9	6
West Damsel	71	4,12	4	0	6
	56	8	4	9	6
	55	8,11	2	17	6
	49	2	1	4	6
	46	3	3	10	6
	40	3	5	16	0
Clifford Amalgamated.. (United Mines)	88	4	4	11	0
Clifford Amalgamated..	66	4	£3	1	0
(United Mines)	36	10,11	1	11	0
	27	8	3	7	0
	21	7	10	14	6
	16	10	2	12	6
Tywarnhaile..............	65	2	2	14	0
	46	5,7	2	9	6
	44	3,5,7	5	2	6
	43	7	3	14	0
	42	3	2	9	6
Craddock Moor	65	4	7	10	0
	45	5,7	7	14	6
	25	10	3	17	0
Wheal Polmear	60	2,3	4	8	0
	50	2	3	18	0
	22	7	7	9	6
South Crinnis	66	11	4	8	6
	49	8,10	5	1	0
North Grambler.........	55	2,7	7	5	6
Grambler & St. Aubyn	35	8	6	10	0
Great Crinnis	34	2,5,7	3	10	6
Great Wheal Basset ...	34	6	3	12	0
Falmouth & Sperries...	26	2,6	3	14	6
Old Tolgus United	15	2	3	7	6
North Wheal Busy......	14	7	7	13	6
East Tolgus	11	12	4	2	6
North Hallenbeagle ...	11	12	6	7	6
Creegbrawse	9	6	3	15	0
New South Ellen........	7	7	5	7	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount. £	s.	d.
Great Wheal Busy	640	1,586	4	0
South Caradon	462	4,406	4	6
Fowey Consols	345	2,258	10	6
West Damsel	317	1,148	13	6
Clifford Amalgamated	254	1,015	3	6
Tywarnhaile	240	777	18	0
Craddock Moor	135	931	7	6
Polmear	132	623	9	0
South Crinnis	115	539	10	0
North Grambler..............	55	400	2	6
Grambler & St. Aubyn......	35	227	10	0
Great Crinnis................	34	119	17	0
Great Wheal Basset	34	122	8	0
Falmouth & Sperries	26	96	17	0
Old Tolgus United...........	15	50	12	6
North Wheal Busy	14	107	9	0
East Tolgus..................	11	45	7	6
North Hallenbeagle	11	70	2	6
Creegbrawse	9	33	15	0
New South Ellen	7	37	9	0

EACH COMPANY'S PURCHASE.

	Tons.		Amount.		
1 Mines Royal Co.	—		—		
2 Vivian and Sons	457		£2,440	5	8
3 Freeman and Co.	208⅜		787	3	4
4 Grenfell and Sons......	278	1-6	1,641	10	5
5 Crown Copper Co. ...	71½		345	17	1
6 Sims, Willyams & Co.	844	5-6	4,346	5	7
7 Williams, Foster & Co.	219		1,288	0	4
8 Mason and Elkington	378⅜		2,476	1	5
9 Bankart and Son	20⅜		50	12	8
10 Copper Miners' Co. ...	144¼		428	12	6
11 Charles Lambert	111¼		399	0	3
12 Newton, Keates & Co.	57⅜		258	7	9
13 Alkali Co.	—		—		
14 Sweetland & Co.........	71		136	13	6
Total...........	2891		£14,598	10	6

verage Produce, 6¼
antity of Fine Copper, 180 tons 7 cwt.

Average Standard £125 0 0
Average Price per ton £5 1 0

Copper Ores.

Sampled February 19, and sold at Tabb's Hotel, Redruth, March 6.

Mines.	Tons.	Purchasers.	Price.		
Clifford Amalgamated	103	2	£5	12	6
(Wheal Clifford)	102	7	6	18	6
	100	7	7	4	6
	97	7	5	0	6
	96	2	6	16	6
	93	7	3	19	6
	80	2	4	17	6
	61	2	3	17	0
	45	3	6	12	0
West Seton	90	4	7	13	0
	74	5,7	8	17	6
	63	10	2	13	0
	55	4,5,7	9	0	6
	54	10	2	12	0
	50	4	4	15	6
	49	7	5	7	6
	42	7	6	15	0
	35	14	1	0	6
Wheal Basset	88	2	5	15	0
	76	7	6	2	6
	32	7	11	13	6
	23	6	7	3	0
South Tolgus	59	3	4	0	6
	48	4	5	2	6
	45	4	10	16	0
	34	4	9	1	6
	32	4	15	0	6
North Roskear	77	3	8	12	6
(Enys)	23	14	3	0	6
North Roskear (Basset)	50	8	4	11	6
(Pendarves)	25	5,7	5	9	6
	21	5,7	4	12	6
South Frances	67	10	5	7	6
	46	5,7,11	5	8	6
	35	6	7	9	6
	20	3	7	3	6
	9	6	3	15	0
Wheal Seton	21	3	5	11	6
(Pendarves)	72	3	4	12	6
	44	4	6	6	6
	14	2,6	13	10	6
North Crofty	78	5,7	4	15	6
	57	10	0	19	0
East Pool	75	14	4	11	6
	53	3,11	4	5	6
East Basset	49	3	4	16	0
	33	2,6	10	13	6
	26	6	5	10	0
West Stray Park	102	5,7	6	11	6
Condurrow	75	10,11	1	19	0
	25	3	5	4	6
Tolcarne	50	11	3	3	6
	37	4	5	8	6
Tresavean	60	6	2	10	6
Cook's Kitchen	40	6	1	7	0
Crane	16	2	6	12	6
Wheal Emily Henrietta	10	2	6	0	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount. £	s.	d.
Clifford Amalgamated	777	£4,442	7	6
West Seton	512	2,970	9	6
Wheal Basset	219	1,509	11	0
South Tolgus	218	1,753	16	6
North Roskear	196	1,195	4	0
South Frances	177	1,048	11	0
Wheal Seton	151	917	14	6
North Crofty	135	426	12	0
East Pool	128	569	14	0
East Basset	108	£730	9	6
West Stray Park	102	670	13	0
Condurrow	100	276	17	6
Tolcarne	87	358	11	0
Tresavean	60	151	10	0
Cook's Kitchen	40	54	0	0
Crane	16	106	0	0
W. Emily Henrietta	19	60	5	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Mines Royal	—	—		
2 Vivian and Sons	477½	£2,802	9	9
3 Freeman and Co.	268½	1,371	19	3
4 Grenfell and Sons	415 5-6	3,222	19	5
5 Crown Copper Co.	183⅔	1,215	11	4
6 Sims, Willyams & Co.	199	948	6	6
7 Williams, Foster & Co.	774⅔	4,887	9	10
8 Mason and Elkington	176	1,126	16	6
9 Bankart and Sons	—	—		
10 Copper Miners' Co.	278½	£794	15	0
11 Charles Lambert	123½	428	6	11
12 Newton, Keates & Co.	—	—		
13 Alkali Co.	—	—		
14 Sweetland and Co.	133	448	11	6
	3036	£17,247	6	0

Average Produce, 6¾.
Quantity of Fine Copper 207 tons 7 cwts.

Average Standard, ... £123 9 0
Average price per ton, £5 13 6

Copper Ores.

Sampled February 26, and sold at Tabb's Hotel, Redruth, March 13.

Mines.	Tons.	Purchasers.	Price.		
West Basset	78	2,4,7,10,11	£4	17	6
	64	8	4	12	6
	63	10	4	12	0
	62	4	3	11	6
	55	7,10	6	8	6
	47	6	6	13	6
	20	4	14	0	6
	14	9	2	5	0
East Carn Brea	81	10	3	13	6
	79	2,7	8	15	6
	66	11	3	19	0
	57	6	3	19	0
	39	7	10	4	6
	24	10	3	15	6
	11	2	9	7	6
Alfred Consols	55	6	1	12	0
	54	6	2	15	6
	53	14	2	18	6
	43	2	9	10	6
	42	2	1	10	6
	32	2	3	7	6
	25	2	10	9	0
Par Consols	76	7	7	12	6
	75	7	8	5	6
	66	2,3	9	3	0
	33	3	4	11	0
Wheal Margery	66	2	2	12	6
	57	14	2	13	6
	56	2,7	7	9	6
	7	2	13	0	6
Tolvadden	50	6,8	2	10	0
	48	14	3	18	6
Tolvadden	44	14	£1	19	6
	31	8	5	2	0
	10	6	12	1	6
Copper Hill	54	6	2	14	6
	38	6	2	4	0
	36	4	6	18	6
	32	6	7	10	0
	7	2	23	0	6
Treworlis	67	7	5	15	6
	48	2,6	6	5	6
	21	2,6	1	4	6
Wheal Buller	89	3	4	10	6
	45	8	10	6	0
	1	6	33	15	0
Wheal Agar	45	4	7	12	0
	43	4	11	14	0
	39	4	7	2	6
East Rosewarne	25	2	12	19	6
	24	14	5	15	0
	20	2	9	0	6
	16	8	3	8	0
North Basset	39	8	3	16	0
	38	3	6	4	0
South Crenver	44	14	2	8	6
	19	9	4	10	6
Rosewarne Consols	31	8	3	12	0
	4	2	29	16	0
West Trevelyan	34	4,8	5	18	0
South Carn Brea	19	3	5	9	6
Clijah and Wentworth	15	11	1	11	6
Wheal Trannack	11	6	3	3	6
Wheal Nelson	10	2	7	16	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
West Basset	403	£2,166	16	0
East Carn Brea	367	2,107	0	0
Alfred Consols	304	1,235	15	0
Par Consols	250	1,954	3	6
Wheal Margery	186	835	10	0
Tolvadden	183	679	3	0
Copper Hill	167	881	4	6
Treworlis	136	713	17	0
Wheal Buller	135	899	19	6
Wheal Agar	127	1,122	19	6
East Rosewarne	85	£697	5	6
North Basset	77	383	16	0
South Crenver	63	192	13	6
Rosewarne Consols	35	385	16	0
West Trevelyan	34	200	12	0
South Carn Brea	19	104	0	6
Clijah and Wentworth	15	23	12	6
Wheal Trannack	11	34	18	6
Wheal Nelson	10	78	5	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Mines Royal	—	——		
2 Vivian and Sons	442¾	£3,171	6	0
3 Freeman and Co.	205	1,116	19	0
4 Grenfell and Sons	277¾	2,050	15	6
5 Crown Copper Co.	—	——		
6 Sims, Willyams, and Co.	418¼	1,662	17	3
7 Williams, Foster & Co.	367¾	2,794	9	6
8 Mason and Elkington	275	1,627	2	0
9 Bankart and Sons	33	117	9	6
10 Copper Miners' Co.	221 1-10	968	11	3
11 Charles Lambert	96¾	360	7	6
12 Newton, Keates & Co.	—	——		
13 Alkali Co.	—	——		
14 Sweetland and Co.	270	827	10	0
Total	2607	£14,697	7	6

Average Produce, 6¾.
Quantity of Fine Copper, 175 tons 10 cwt.

Average Standard, £124 12s. 0d.
Average Price per ton, £5 12s. 0d.

Copper Ores.

Sampled March 6, and sold at the Royal Hotel, Truro, March 20.

Mines.	Tons.	Purchasers.	Price.		
Devon Great Consols	125	6	£3	11	0
	119	10	4	4	6
	110	4	9	4	6
	107	12	4	12	0
	104	12	8	1	0
	103	8	4	9	0
	102	10	4	6	0
	97	11	4	4	6
	94	11	3	6	0
	89	11	3	14	6
	84	4	9	4	6
	81	3	4	7	0
	79	4	3	8	0
	75	11	2	3	0
	72	4	11	15	0
	70	6,11	1	6	0
	69	3,7	3	19	6
	68	11	1	5	6
	64	14	2	12	6
	61	4	7	9	0
	60	2	3	2	0
	59	3	4	12	6
	55	11	1	13	0
	51	11	2	19	6
	50	11	0	18	0
	15	4	11	2	6
East Caradon	104	14	5	6	6
	96	6	6	0	6
	80	6	6	3	0
	57	2,6	8	8	6
	42	2	8	0	6
	34	2	16	11	0
Marke Valley	115	11	4	5	6
	90	3	4	19	0
	78	11	3	18	6
	70	5,7	5	10	6
	22	6	2	4	6
Hingston Down	95	2	3	0	6
	81	7,10	2	18	6
	80	2	3	2	6
	57	12	4	17	6
	47	2	6	2	6
Phœnix Mines	85	8	3	7	6
	73	8	3	16	6
	60	6	2	8	6
	50	9	4	4	0
	46	4,6	11	17	0
	12	14	4	7	6
Holmbush	71	2,7	11	15	6

Mines.	Tons.	Purchasers.	Price.		
Holmbush	60	4,7	£6	17	6
	58	2,7	12	14	6
	56	4,11	3	5	0
	55	14	2	3	6
Great Wheal Martha	75	14	2	7	6
	70	2,6	1	11	6
	67	2,6	1	9	0
	50	6	3	19	6
East Russell	92	9	3	19	6
	66	11	3	4	0
	54	2,4,6	8	8	6
	36	6	3	19	0
Lady Bertha	110	9	2	1	0
	100	14	3	13	6
	30	7	8	9	6
Bedford United	110	5,7	4	13	6
	108	5,7	4	1	6
Calstock Consols	95	7	4	1	0
	45	11	1	2	0
	40	7,14	2	13	6
Wheal Yarner	127	14	2	16	6
	36	2	5	2	6
Wheal Friendship	91	7	3	17	6
	64	7	10	2	6
Wheal Emma	73	14	4	8	6
	40	2,6	10	9	0
	39	4	2	1	6
Kelly Bray	75	7,8	3	18	6
	54	11	1	3	0
	21	3,8,10	5	6	0
Gunnis Lake (Clitters)	78	7	6	7	0
	42	10	3	10	0
Okel Tor	100	14	2	0	6
	20	4	0	11	6
South Bedford	75	8,11	1	16	0
	20	7	6	3	6
Trehill	40	2,6	1	15	0
	16	2,6	1	7	0
Bampfylde	41	6	18	6	6
Brookwood	35	3,4	5	17	6
•	2	4	20	17	0
Gawton	37	8	3	16	6
Hawkmoor	17	3	5	10	0
	14	12	6	6	6
New Cornish Co.	23	9	2	10	6
Fursdon	15	10	5	8	6
Crowndale	12	8	2	2	6
Great Tregune	10	6	9	3	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Devon Great Consols	2063	£9,629	18	6
East Caradon	413	3,004	3	6
Marke Valley	375	1,678	19	6
Hingston Down	360	1,340	1	0
Phœnix Mines	326	1,519	4	0
Holmbush	300	2,288	4	0
Great Wheal Martha	262	584	5	6
East Russell	248	117	4	1
Lady Bertha	240	847	5	0
Bedford United	218	954	7	0
Calstock Consols	180	541	5	0
Wheal Yarner	163	543	5	6
Wheal Friendship	155	1,000	12	6
Wheal Emma	152	821	19	0
Kelly Bray	150	£467	15	6
Gun. Lake (Clitters)	120	644	5	0
Okel Tor	120	214	0	0
South Bedford	95	258	10	0
Trehill	56	91	12	0
Bampfylde	41	751	6	6
Brookwood	40	264	19	0
Gawton	37	141	10	6
Hawkmoor	31	182	1	0
New Cornish Company	23	58	1	6
Fursdon	15	81	7	6
Crowndale	12	25	10	0
Great Tregune	10	91	10	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Mines Royal	—	——		
2 Vivian and Sons	621	£3,632	16	0
3 Freeman and Company	307	1,450	1	9
4 Grenfell and Sons	600	4,492	15	6
5 Crown Copper Co.	144	670	11	0
6 Sims, Willyams & Co.	741	3,960	13	9
7 Williams, Foster & Co.	749	4,480	10	0
8 Mason and Ellington	392	1,343	5	3
9 Bankart and Sons	275	£859	5	6
10 Copper Miners' Co.	325	1,325	6	3
11 Charles Lambert	1037	2,911	11	0
12 Newton, Keates & Co.	282	1,695	16	6
13 Alkali Company	—	——		
14 Swettland and Co.	730	2,377	7	0
Total	6205	£29,199	19	6

Average Produce, 5⅞.
Quantity of Fine Copper, 356 tons 18 cwt.

Average Standard, £129 12s. 0d.
Average Price per ton, £4 14s. 0d.

Copper Ores.

Sampled February 5, and sold at Swansea, February 25.

Mines.	Tons.	Produce.	Purchasers.	Price.			Mines.	Tons.	Produce.	Purchasers.	Price.		
Cobre	96	11⅝	9	£9	4	6	Californian	64	23¾	7	£20	18	0
	95	11⅝	9	9	4	6		60	22¼	3	19	14	0
	94	11⅝	1	9	4	6		59	24¼	3	21	10	0
	93	11⅝	6	9	2	0		7	20	3	17	10	0
	85	11⅝	7	9	7	6	Seville ore	62	8¾	6	7	5	0
	49	21¼	2,7	18	14	0		5	8⅝	6	7	2	0
	47	21¼	5,10	18	4	6		2	15¾	6	13	3	0
	40	21¼	3,10	18	15	0		1	24¼	16	20	13	0
	6	58	5	50	0	0	Trump Island	27	7¾	6	6	10	0
Californian	76	24	2,7	21	3	0	Bristol Reg.	8	43	5	38	7	0
	64	23¾	7	20	18	6	Erin's ore	2	3	6	1	19	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.				Tons.	Amount.		
Cobre	605	£7,095	3	6	Trump Island	27	£175	10	0
Californian	331	6,878	2	6	Bristol Regulus	8	306	16	0
Seville ore	74	566	8	0	Erin's ore	2	3	18	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.				Tons.	Amount.		
1 Copper Miners' Comp.	94	£867	3	0	10 Mason and Elkington	43½	803	5	9
2 Freeman and Co.	62½	1,261	17	0	11 Bankart and Sons	—	—		
3 P. Grenfell and Sons	146	2,948	0	0	12 Charles Lambert	—	—		
4 Crown Copper Co.	—	—			13 Ravenhead Copper Co.	—	—		
5 Sims, Willyams & Co.	37½	1,035	1	9	14 Sweetland and Co.	—	—		
6 Vivian and Sons	195	1,571	9	0	15 Bold Copper Co	—	—		
7 Williams, Foster & Co.	276½	4,756	9	0	16 Jennings and Co.	1	20	13	0
8 Mines Royal	—	—							
9 British & For. Cop. Co.	191	1,761	19	6	Total	1047	£15,025	18	0

Copper Ores.

Sampled February 19, and sold at Swansea, March 11.

Mines.	Tons.	Produce.	Purchasers.	Price.			Mines.	Tons.	Produce.	Purchasers.	Price.		
Knockmahon	71	8¾	6	£7	6	0	Berehaven	131	10⅝	3,10	£9	1	0
	63	8⅝	6	7	6	0	Springbok	45	41¼	6	37	3	0
	59	11¼	6	9	16	0		36	41¼	6	37	3	0
	63	10⅝	7	8	19	6	Burnt ores	34	3	7	2	2	0
	62	10⅝	6,10	8	19	0	London slags	20	7½	16	6	1	6
Cobre	90	10⅝	14	9	0	0		2	21½	5	18	12	0
	68	10¾	6	9	1	0		1	48	5	41	10	0
	48	21¼	3	19	0	6	Seville ores	56	9½	7	7	13	0
	41	21⅝	5,7	18	15	0		1	14¼	7	12	6	0
	27	20	3	17	15	0	Eng. and Canad.	18	34	2	30	15	0
	10	14¼	16	12	19	6		16	41	2	37	6	0
	7	58	5	48	10	0	Mixture	38	7½	1,7	6	6	6
	9	14⅝	3	12	10	0							

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.				Tons.	Amount.		
Knockmahon	318	£2,676	14	6	London slags	23	£200	4	0
Cobre	300	4,168	7	0	Seville ores	57	440	14	0
Berehaven	131	1,185	11	0	English and Canadian	34	1,150	6	0
Springbok	81	3,009	3	0	Mixture	38	240	7	0
Burnt ores	34	71	8	0					

EACH COMPANY'S PURCHASE.

	Tons.	Amount.				Tons.	Amount.		
1 Copper Miners' Comp.	19	£120	3	6	10 Mason and Elkington	96½	870	4	6
2 Freeman and Co.	34	1,150	6	0	11 Bankart and Sons	—	—		
3 P. Grenfell and Sons	149½	2,097	14	6	12 Charles Lambert	—	—		
4 Crown Copper Co.	—	—			13 Ravenhead Copper Co.	—	—		
5 Sims, Willyams & Co.	30½	802	11	6	14 Sweetland and Co.	—	—		
6 Vivian and Sons	373	5,458	8	0	15 Bold Copper Co.	—	—		
7 Williams, Foster & Co.	193½	1,582	1	6	16 Jennings and Co.	30	251	5	0
8 Mines Royal	—	—							
9 British & For. Cop. Co.	—	—			Total	1016	£13,142	14	6

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Feb. 25.	Minera	120	12	15	6	Jones, McNicol & Co.			
	„	100	12	10	0	W. J. Cookson & Co.			
	„	100	12	12	6	Walker, Parker & Co.			
	„	100	12	16	6	Locke, Blackett & Co	6237	13	0
	„	31½	12	16	6	ditto			
	„	31½	12	16	6	Jones, McNicol & Co.			
	„	7	14	10	6	Walker, Parker & Co.			
„ 27.	Westminster	50	12	1	6	Walker, Parker & Co.	603	15	0
	Maesysafn	50	12	5	0	Adam Eyton	612	10	0
	Mount Pleasant	35	12	4	0	Walker, Parker & Co.			
	„	12	14	2	6	ditto	737	15	0
	„	5	14	2	6	Adam Eyton			
	„	5	14	2	6	Walker, Parker & Co.			
	Hendre Ucha	14½	12	3	6	ditto	176	10	9
	Roman Gravels	30	12	15	6	ditto	383	5	0
	Bryntail	11½	12	7	6	ditto	142	6	3
	Wheal Mary Ann	60	25	2	6	Stock & Co.	1507	10	0
„ 29.	Isle of Man Mining Co.	100	23	8	0	Sims, Willyams & Co.	2340	0	0
Mar. 1.	Newtownards	55	12	6	0	Mining Co. of Ireland	676	10	0
	Penpompren	20	13	13	0	Sims, Willyams & Co.	273	0	0
„ 3.	Glogfach	60	15	2	6	Mining Co. of Ireland	907	10	0
	East Logylas	70	12	1	6	Walker, Parker & Co.	845	5	0
	Cwmyswith	100	12	1	6	ditto	1207	10	0
„ 4.	North Minera	30	11	17	6	ditto	356	5	0
„ 5.	Dyliffe	66	12	11	0	ditto	1513	1	0
	„	55	12	9	0	ditto			
	Dyfngwm	28	12	1	6	ditto	338	2	0
	Llanerchyraur	42	13	12	0	Adam Eyton	571	4	0
	Rhoswydol	10½	11	9	6	Newton, Keates & Co.	120	9	9
„ 8.	Llanfyrnach	20	12	18	0	Sims, Willyams & Co.	258	0	0
„ 10.	Lot 1 (ex *Helena*) Liverp.	50	10	17	6	Walker, Parker & Co.			
	2 „	50	10	17	6	ditto	1631	5	0
	3 „	50	10	17	6	ditto			
„ 13.	Chiverton	53	17	0	6	R. Michell & Son	1024	3	0
	„	33	11	1	6	ditto			
	Talargoch (Maesyrerwddu)	58	12	16	6	Walker, Parker & Co.	1098	12	0
	„ (Coetia Llys)	27½	12	18	0	Adam Eyton			
	Deep Level	15	11	14	0	Walker, Parker & Co	175	10	0
	Brynford Hall	5½	11	11	0	ditto	63	10	6
	Herward United	10	10	19	0	ditto	109	10	0
	Rhosesmor	45	11	16	0	Adam Eyton	531	0	0
	Orsedd	10	12	7	6	Walker, Parker & Co.	123	15	0
	Parys Mine	35	12	12	6	ditto	441	17	6
	Long Rake	15	12	5	6	ditto	184	2	6
	Grosvenor	6	11	16	6	ditto	70	19	6
	West Merllyn	3	12	10	0	ditto	37	10	0
	Lady Eleanor	3¼	12	8	6	ditto	40	7	7
	Holywell Level	10	13	13	6	ditto	136	15	0
	Dyliffe	50	12	0	6	ditto	601	5	0
	Dyfngwm	32	11	13	6	Newton, Keates & Co.	373	12	0
	Rhoswydol	26	11	6	6	Walker, Parker & Co.	294	9	0
	Llangynog	15	11	15	6	ditto	176	12	6
„ 17.	Frongoch	90	11	10	6	Panther Co.	2065	10	0
	„	90	11	8	6	ditto			
	East Darren	70	15	3	6	R. Michell & Son	2707	0	0
	„	70	14	18	6	ditto			
	Cefn Brwyno	41	12	1	0	Sims, Willyams & Co.	494	1	0
	Cwm Erfin	25	15	0	0	ditto	737	10	0
	„	25	14	10	0	Panther Co.			

Black Tin Sales.

Date.	Mines.	Tons	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.
Feb. 22.	Drake Walls.........	6	10	0	0 ...	72	0	0 ...	R. Michell & C
	"	6	5	0	0 ...	67	12	6 ...	Daubuz & Co.
	"	6	5	0	0 ...	67	12	6 ...	Bissoe Compan
"	Trevenen	5	3	0	14 ...	72	0	6 ...	——
	"	0	17	0	6 ...	46	0	0 ...	——
" 22 & 27.	Tincroft	9	13	2	17 ...	65	10	0 ...	——
	"	6	6	1	16 ...	66	10	0 ...	Bolitho & Sons
	"	5	7	3	3 ...	70	5	0 ...	——
" 28.	Gt. Wh. Fortune ...	20	2	2	2 ...	—		...	——
"	Basset & Grylls......	18	15	3	27 ...	—		...	——
March 6.	Gurlyn	5	11	3	16 ...	65	10	0 ...	Chyandour ....
8.	Penhalls	4	17	0	22 ...	66	0	0 ...	Bissoe Company
	Kitty (St. Agnes)...	7	14	0	2 ...	59	0	0 ...	——
" 11.	Brea Consols.........	3	17	0	12 ...	72	0	0 ...	R. Michell & Co.
	"	0	17	2	5 ...	61	0	0 ...	—— ......
	"	0	4	2	2 ...	41	0	0 ...	—— ......
" 12.	Kitty (St. Agnes)	1	7	0	14 ...	59	0	0 ...	Daubuz & Co. ......
" 15.	Garlidna	7	3	2	17 ...	69	0	0 ...	Bissoe Company ......
	"	1	17	3	16 ...	50	0	0 ...	—— ......
	Gt. Wh. Fortune...	15	7	2	15 ...	—		...	—— ......
	Gt. Wheal Vor	22	1	2	26 ...	—		...	—— ......
	South Carn Brea ...	5	15	1	9 ...	62	15	0 ...	Trethellan Co. ......
	"	5	14	3	16 ...	63	12	6 ...	Chyandour ....
	Pedn-an-drea	7	19	3	25 ...	—		...	Bissoe Company ......

Tin ores being sold by private contract, the particulars are not generally publi sible. We hope, however, to be able to provide monthly a tolerably complete list of this metallic ore: the above list gives no adequate idea of the real sales.

Sundry Copper Ore Sales.

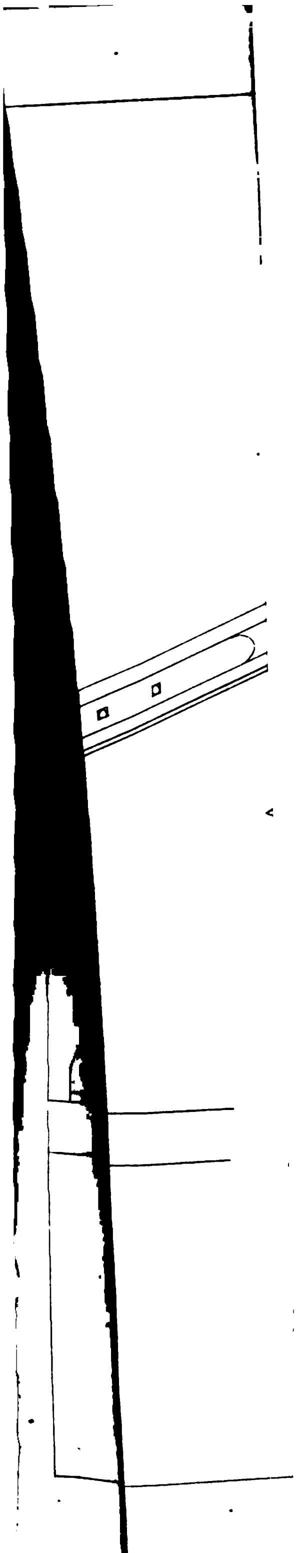
Date.	Mines.	Tons	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £
Feb. 7.	Alderly Edge (precipitate)	18	11	1	0 ...	57	15	10 ...	Sims, Willyams & Co.	1778
"	....	12	1	3	0 ...	58	10	0 ...	——	

Sold at Liverpool, by Mr. James Hallows.

Date.		Tons.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £ s. d.
" 25.	Lot 1 (ex *Annie Bragington*)	75 ...	20	4	6 ...	Newton, Keates & Co. ...	6107 16 3
	2 "	75 ...	20	0	6 ...	ditto	
	3 "	75 ...	20	3	9 ...	J. Keys & Son	
	4 "	75 ...	21	0	0 ...	ditto	
	7 (ex *Polesiar*)	70 ...	19	14	0 ...	P. Grenfell & Sons	8225 0 0
	8 "	70 ...	19	14	0 ...	ditto	
	9 "	70 ...	19	9	0 ...	Sims, Willyams & Co. ...	
	10 "	70 ...	19	5	0 ...	P. Grenfell & Sons	
	11 "	70 ...	19	14	0 ...	ditto	
	12 "	70 ...	19	14	0 ...	ditto	
March 18.	Parys Mines	350 ...	5	11	6 ...	C. Lambert	1951 5 0

Blende Sales.

Date.	Mines.	Tons.	Price per ton. £	s.	d	Purchasers.	Amount of Money. £ s. d.
Feb. 25.	Minera.........................	44 ...	2	5	0 ...	W. Kenrick.....................	202 0 0
"	....	19 ...	2	0	0 ...	ditto	
"	....	19 ...	2	0	0 ...	A. Courage & Co............	
"	....	18 ...	1	10	0 ...	W. Kenrick.....................	



THE

MINING AND SMELTING MAGAZINE.

MAY, 1862.

The Coal Fields of North Wales.

BY EDWARD HULL, B.A., F.G.S.,
Of the Geological Survey of Great Britain.

THE Carboniferous Rocks in Lancashire and Cheshire, which plunge below the Triassic and Permian formations along their southern and western margins, again re-appear, rising from beneath these newer strata, in Flintshire and Denbighshire. The great oval plain of New Red Sandstone and Marl, enclosed along four-fifths of its circumference by Carboniferous and older Palæozoic Rocks, which occupies the greater portions of Cheshire and Salop, may be regarded as very nearly a true basin—with an inlet at the north-west—in the peninsula of Wirral, and an outlet at the opposite side, communicating with the broad band of the same formation which traverses England from Devonshire to Durham—from the English Channel to the North Sea. As political economists, we might well regret that so large an area, probably 1500 square miles, of coal-bearing strata should be hopelessly buried beneath strata of comparatively small utility in regard to their mineral productions. It has been long a favourite speculation amongst geologists more or less versed in the stoney science (for, unhappily, like the term "professor," the name of geologist is usurped by many who would be hard put to it to establish a title), that the great saliferous basin of Cheshire is a storehouse of coal for the supply of future generations. Closer examination, however, leads us to impugn the latter part of this proposition, while fully admitting the former. There can scarcely be a doubt that coal does underlie this area. The known succession of the strata, and the dip of the Coal-measures in the direction of the margin of the basin along the west, north, part of the east, and south, all lead to this conclusion; but the *depth*, as indicated by the thickness of the overlying strata, *that* is the question which, when looked into in detail, obliges us to banish all visions of future collieries usurping the farmsteads of Cheshire. A very few words will probably be sufficient to establish this conclusion.

It so happens, that the New Red Sandstone attains in this district a development greater than in any other part of England. The

Bunter, or lower division, has a thickness of 1000 to 1500 feet, while the Keuper, or upper division, is in all probability considerably thicker, falling little short of 3000 feet. If to these we add 2000 feet for Permian and the Upper Coal-measures, which overlie the workable coal-seams, there will be in all from 4000 to 5000 feet of strata superimposed upon the coal over by far the larger portion of this wide-spread plain; at least all that part of it occupied by the upper division of the Trias.

Such being the case, with reference to the greater portion of the Cheshire Basin, it by no means follows that there are actually no spots in which coal may be inferred to lie at accessible depths. On the contrary, we are somewhat sanguine regarding the coal-bearing capabilities of that very important district lying between the extreme south-western margin of the Lancashire coal-field, and the coal-fields of Flint and Denbigh. This embraces the peninsula of Wirral, between the estuaries of the Mersey and the Dee; certain parts of the district east, and south of Liverpool; and the neighbourhood of Chester. The tracts here referred to are composed of the *lower division* of the Trias, and they are traversed by systems of faults,* along which very low beds of that formation are upheaved in certain directions. Some of these faults are up-throws of 500 or 600 feet, and it is evident that displacements of the strata to that amount may one day be found of extreme utility in lessening the depth of the coal-bearing rock. In the author's opinion, there are several localities within short distances of Chester and Liverpool where coal might be reached at depths varying from 400 to 500 yards and upwards.

It unfortunately happens, that several experiments, which have been made for coal in these districts, have been undertaken unadvisedly, and in ignorance of the true sequence of the strata. Thus, instead of the sinkings having been made in the lowest available strata of the Trias, the places selected were situated on beds high up in the series. In one spot, near Warburton, the Keuper shales were mistaken for Permian Magnesian Limestone; and great was the surprise of the workmen when, after passing through these beds, they entered (instead of Coal-measures) the red sandstone of the Bunter. A similar mistake was made at Lymm in Cheshire; and, in a third instance, near Hoylake some miles west of Birkenhead, the place selected for boring was situated in the highest sub-division of the Bunter sandstone, in spite of the fact, that lower beds of that formation lay close at hand and actually dipped *towards* the spot where the experiments was being carried on. In all these cases, failure was the result of ignorance, and should not be regarded as prejudicing the question of the accessibility of coal within the district occupied by the New Red Sandstone. They form a part of a large catalogue of profitless experiments, in which money has been wasted, and only disappointment gained; experiments undertaken at the instance of "practical men," whose verdict—"that it is a likely place for coal" —has been acted upon, while no opinion has been asked of the educated geologist. The aggregate sum thrown away in undertakings

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* These faults are traced on the maps of the Geological Survey, and are likely one day to be found of economic value when the question comes to be discussed as to the best sites for collieries.

of this kind has been calculated as sufficient to pay for the whole cost of a geological survey of the United Kingdom. We trust, however, the days of this ignorance are passing away; that the opinion of a mining surveyor, whose knowledge extends no farther than the borders of a coal-field, will not be considered as entitled to respect beyond that province. The value of theoretical geology is becoming more felt and allowed, and must become daily more indispensable to the success of all projects having reference to water supply, and the raising of coal in previously unproved districts.

The range of Moel Fammau, which forms a conspicuous and pleasing feature when viewed from every elevation of Cheshire and South Lancashire, descends by a series first, of smooth and steep shoulders, then, of terraces and broken ridges, towards the valley of the Dee and the plains of England. The strata arrange themselves in a series of parallel bands, trending generally from north to south, and broken through by several cross fractures, only one of which, however, seriously affects the general uniformity of this meridianal arrangement of the rocks. This great fracture, which here has caused the severance of the Flintshire from the Denbighshire coal-field, is one of the most remarkable in Britain, as it has been traced for a distance of about sixty miles along the northern basis of Cyrn-y-Brain, through Bala Lake to the coast of Merionethshire. It has apparently been produced previously to the Triassic period, as it is lost beneath this formation a little to the south-east of Hope, without producing any apparent displacement of the beds. It ranges a little north of east, and on the north side the beds of Millstone Grit and Carboniferous Limestone are upheaved, and the Coal-measures nowhere reach across from the Denbigshire side to that of Flintshire.

The general direction of the dip of the Coal-measures in both coal-fields is easterly; and they are alternately covered over by Permian and Triassic formations, which form the boundary of the coal-fields along a line running nearly north and south from the river Dee near Broughton to Oswestry, passing by Wrexham and St. Martin. The Permian strata are composed of red and purple marls and sandstones, dipping in the same direction as the Coal-measures. Under them the coal-seams dip, and may one day be followed; but probably never very far, as they are of great thickness, and dip rather steeply.

Of the Coal-measures, we shall presently speak more in detail. It is here their nature, as elsewhere, to form a tract of depressed and rather level ground. The strata are generally concealed by an enormous accumulation of Drift-deposits, consisting principally of gravel with boulders; so that, except in the deep river-courses, they are seldom visible.

In the centre of the Flintshire coal-field the beds are spread out to a breadth of about six miles, principally through the agency of faults which repeat the beds several times successively from east to west. In Denbighshire they contract in breadth, and gradually arrange themselves into the form of a solid compact mass, narrowing to a point a short distance south of Oswestry. Here they are completely overlapped by the Triassic and Permian rocks, which pass over the beds, and abut upon the Carboniferous Limestone. The Coal-measures again appear on the south of the valley of the Severn at

Alberbury, and form a narrow belt extending to Haughmond Hill, near Shrewsbury.

The rising ground to the west of the coal-fields marks the position of the Millstone Grit, which forms one of the meridianal bands of elevated and broken ground already spoken of. The thickness of this series varies from 1000 to 1500 feet, decreasing from north to south; it contains one or two seams of workable coal. Beyond its westerly margin is a parallel band formed of Carboniferous Limestone, this formation frequently presents in strong relief those terraces which distinguish it in its outward aspects from the neighbouring strata. The beds of partially bare limestone may be observed rising from beneath each other in succession, and ending off in abrupt faces of cliff. In the heights above Llangollen this feature is particularly striking, and the author has a vivid recollection of the effect produced on his own mind, when for the first time he caught sight of those mighty walls of grey rock ranging for several miles from north to south, tier above tier, appearing like colossal breastworks thrown up by some race of Titans to defend the plains of England from the warriors who peopled the mountains of Wales. In truth, however, the work is too stupendous for any race of gods or men. The architects were the Polypes of the deep, and those walls were shaped and chiselled by the waves of old Atlantis, which once chafed and flung themselves against their bases.

The Carboniferous Limestone is of special interest to the mineralogist, as being the repository of several systems of mineral veins. The tract of country from the sea-coast near Rhyl to the north of Llangollen has for many centuries been the site of mines from which argentiferous galena, calamine, and blende have been extracted. From the discovery of stone-headed hammers in some of the old works of this part of the country, it is probable these operations were commenced in the time of the ancient Britons; that they were worked in the Roman times is certain, and the present yield, according to the returns collected by Mr. R. Hunt, for 1860, are as follows:—

	DENBIGHSHIRE.	FLINTSHIRE.
Lead ore	6,182 tons 9 cwts.	4,947 tons 19 cwts.
Lead	4,714 „ 3 „	3,767 „ 10 „
Silver........	16,661 ozs.	31,092 ozs.

The lodes in this district, as laid down on the Maps of the Geological Survey by Mr. Warington Smyth, appear in greatest number at the junction of the Millstone Grit and Carboniferous Limestone, including strata of both formations. Many of the lodes are faults, and they range generally across the strike of the beds—that is to say, approximately from east to west. In the direction of Holywell, there are great beds of chert intercalated with the limestone, and the lodes in this position are generally very productive. One of the most remarkable lodes in this district is the "Great Minera Vein," the most productive in North Wales. It is a fault ranging north-west, and having a down-throw to the north-east of about 350 yards. It has been worked from very ancient times, and in 1860, yielded upwards of 4000 tons of lead ore, and 1125 tons of zinc ore (blende). This great fracture enters the Denbighshire coal-fields, and probably produces important changes in the strata; its effect, however, has

not yet been ascertained, as the strata are not yet explored in the direction of its prolongation. Besides the lodes already referred to, there are several remarkable longitudinal fissures traversing the limestone in the direction of the strike from north to south. They cut down through the strata to a great but unknown depth, and are filled with rubbish; they are not generally metalliferous. One of these, called the "Catshole cross course," has been traced for a distance of twelve miles from Holywell southwards, and at its northern extremity it becomes a lode.*

We now proceed to the more immediate subject of this article—the description of the coal-fields themselves; having laid a foundation for this superstructure by the above somewhat desultory account of the rocks which immediately underlie the coal-formation.

The Flintshire and Denbighshire coal-fields were originally continuous with each other, as they each present a similar succession of strata, and the coal-series of each is almost identical. Of the two fields, the Denbighshire is by far the most economically important, not only from its greater area, but on account of the arrangement of the strata. While the coal-seams in Flintshire are repeatedly dislocated and thrown out by faults, which almost invariably prevent their attaining great depths,—those of Denbighshire, for the most part, dip steadily eastward, and are covered over by conformable strata, under which they may eventually be followed to the limiting depth of coal-mining. From this it arises, that while the one is rapidly approaching exhaustion, the other is practically inexhaustible.

FLINTSHIRE COAL-FIELD.

Northward, the boundary of the Flintshire coal-field is the estuary of the Dee—westward and southward, the Millstone Grit. From the Point of Air to Bagillt, near Flint, there occurs a narrow hand, sometimes interrupted, of Coal-measures, in which there are a few collieries, one of which has an air-shaft about a mile out from the margin of high water mark. We are not certain whether it is at present in use. From Bagillt, southwards and south-eastwards, extends the main area of the field. A large portion of this, extending from the shore inwards towards Northop, is composed of Lower Coal-measures with only thin seams. The most important tract is that which stretches from Mold to Hawarden and the Dee, and southwards to Treiddyn. Nevertheless, such is the dislocated state of the beds, that nearly all the thick coals are thrown out three or four times in succession, after having "set in" along certain bands of country stretching north and south. The depth over these bands being nowhere great, much of the coal has already been raised, and there is little prospect of the discovery of large tracts of new ground, unless by sinking over the wide tract of alluvium which borders the Dee.

The general succession of the coals, and their intervening strata over the central part of the coal-field, is very well illustrated by the following section taken at Rhyd-y-Craliad Colliery,† near Mold.

* See Map of the Geological Survey, 79 S.E.; also Horizontal Section, sheet 43.

† From the "Explanation" of Horizontal Section of the Geological Survey, sheet 43. The section above given is abridged from the original.

COAL-SERIES NEAR MOLD, FLINTSHIRE.

	Yds.	Ft.	In.
Strata, principally black shale	6	2	0
Four-feet Coal, with a band of cannel at bottom	0	4	0
Strong black shale	1	0	0
Light blue shale	1	0	2
Black-band Ironstone	0	0	10
Light blue shale with sandstone	1	2	6
Sandstone with shale	2	0	0
Shale with ironstone	0	2	6
Light blue shale with sandstone	5	2	6
Bind Coal	0	2	6
Light blue shale with ironstone	6	1	0
Sandstone with blue shale	4	1	0
Sandstone, very hard (Hollin Rock)	2	2	0
Strong blue metal (shale)	4	0	0
Hollin Coal, in three beds	2	0	6
Cannel	0	1	6
Strong blue shale	2	2	0
Shale, with three beds of ironstone	0	2	0
Blue shale	1	1	0
Sandstone and shale	1	0	0
Strong blue shale (good roof)	3	0	0
Brassy Coal	1	0	0
Shale	13	0	0
Sandstone	8	0	0
Shale	4	0	0
Main Coal	2	1	0

The *Main Coal* is everywhere a most valuable seam. Though only seven feet in thickness at Mold, it becomes as much as eleven or twelve feet in the direction of Hawarden, and is even thicker at the new colliery recently commenced there. At Bryn-ffymon, a four feet coal has been worked, which is supposed to lie sixty-five yards below the *Main seam*. The *Cannel* seam, recently opened up at Leeswood, but which, I am assured by Mr. P. Higson, jun., who is well acquainted with the district, has been worked many years since, and was known to the miners as a sort of black bass, having a marvellous power of blazing when ignited, lies about 100 yards below the *Main Coal*. It is probably identical with the *Four-feet* seam mentioned above, as there is good evidence for believing that it passes into a seam of ordinary coal in other districts. At Leeswood, however, it occurs as one of the most valuable seams of cannel in the kingdom, yielding, in its lower part it is said, 1500 or 2000 cubic feet of gas per ton more than the celebrated cannel of Wigan. It is probably rich also in mineral oil. The following is the section at Leeswood:—

SECTION THROUGH THE CANNEL SEAM AT LEESWOOD.

	Yds.	Ft.	In.
Black shale	3	2	8
Light shale	0	0	7
Black bass, called "slag"	0	0	7
Top cannel	0	2	2
Curly cannel	0	1	8
Bastard do.	0	1	5
Black shale	0	3	0

It may prove worth the while to proprietors, who possess property over this field in which the *Main Coal* has been worked, to ascertain,

by boring, whether a seam, calculated to bring so large a profit as this, may not exist under their estate. Of its great value for the production of gas there can be no doubt.

At the base of all these coal-seams there occurs a considerable thickness of strata, principally shales, belonging to the Lower Coal-measures, and resting upon the Millstone Grit. The seams they contain are thin, and rarely worked.

The area of the Flintshire Coal-field is about 35 square miles. More than half the original quantity of coal has either been raised or destroyed, leaving about twenty millions of tons for future supply. In 1860, there were 590,500 tons of coal raised, so that, *at the present rate* of production, this supply would only last for about 35 years. The number of collieries in work in the same year was 40.

THE DENBIGHSHIRE COAL-FIELD.

The northern extremity of this coal-field terminates along the great fault already described, about one mile south of Hope. Leaving this line, and gradually receding from it, the base of the Coal-measures bend round southward by Minera, and thence takes a due southerly course, crossing the Dee at Pont Cysyllian, where the strata are traversed by a large fault, and extending thence to Trefonen, south of Oswestry. Its length is about eighteen miles, and its breadth, at Wrexham, about four and a-half miles. Towards its southern extremity, it contracts considerably—probably from two causes: first, the overlapping of the New Red Sandstone; and secondly, from the gradual thinning of the strata in that direction.

Throughout its whole length the dip is easterly, and the inclination generally lessens towards its eastern margin. Nowhere, except in the immediate neighbourhood of faults, is the dip very steep—the average being about 10 degrees. Along the valley of the Alyn, near Gresford, the dip of the Upper Coal-measures varies from 5° to 10°. This is also the dip in and around Ruabon, Wynnstay, and on the south bank of the Dee; and, as most of the seams are at accessible depths under these tracts, they are calculated to become of extreme value for future supply, although still unbroached. The general structure of this coal-field may be expressed by the accompanying section drawn across the noble escarpment of Cefn-y-Fedw, and the town of Ruabon.

The general series of the main portion of the Denbighshire Field is as follows:—

Permian Strata.—Probably attaining a thickness of 2,000 feet, consisting of interstratified red, purple, and brown sandstones (sometimes calcareous) and marls. These beds are well shown in the River Clywedog near Wrexham, and in the Valley of the Dee between Plas-yn-coed and Eyton Hall.

Upper Coal-measures.—About 1,000 feet in thickness. They consist of greyish and yellow sandstones, with coal-plants, interstratified with red and grey clays and shales. There are a few very thin coal-seams, but never of workable thickness. This series is well shown along the banks of the Alyn, from Gresford westward, also around Ruabon, Wynnstay, along the Dee, near its junction with the river Ceiriog.

Middle Coal-measures.—About 800 feet in thickness. Consisting of grey and yellow sandstones, clays, shales, with bands of valuable ironstone and beds of coal. Over these strata the principal collieries are situated.

Lower Coal-measures.—About 1,000 feet in thickness. Consisting of shales and sandstones, with a few thin seams of coal.

SECTION ACROSS THE DENBIGHSHIRE COAL-FIELD.

S. Silurian Schists, contorted. L. Carboniferous Limestone. M. Millstone Grit.
C. Middle and Lower Coal-measures, with Coal-seams. D. Upper Coal-measures.
E. Permian Strata.

The coal-series is very similar to that of Flintshire. At this northern extremity the strata present the following section, taken at Westminster Colliery:—*

COAL SERIES AT WESTMINSTER COLLIERY.

	Yds.	Ft.	In
Top stinking Coal (bad quality)	1	1	0
Strata	70	0	10
Bottom stinking Coal	1	1	6
Strata	10	0	0
Smith Coal	0	2	2
Strata	12	1	6
Drowsall Coal	1	0	0
Strata	9	0	8
Powell Coal	1	0	3
Two Yards Coal	2	0	0
Strata	9	1	3
Crank Coal	0	2	8
Strata	11	0	0
Brassy Coal	1	2	0
Strata	10	2	6
Main Coal (with partings of shale)	2	1	5

We may recognise a similar succession in the following section taken at Ruabon,† though under different names, and somewhat altered circumstances:—

COAL SERIES AT RUABON.

	Yds.	Ft.	In.
Rough Rock (sandstone)			
Footrell Coal	1	0	0
Strata	42	0	0
Whithurst Coal	2	1	0
Strata	44	0	0
Warras Coal	0	2	0
Strata	8	0	0
John o'Gates Coal	in several beds		
Strata	30	0	0
Coal and Cannel	variable		
Strata	29	0	0
New Coal	1	2	6
Strata	13	0	0
Three Yards Coal	2	2	0
Strata	21	0	0
Brassy Coal	0	2	9
Strata	34	0	0
Upper Yard Coal	1	0	0
Strata	1	0	0
Red Coal	0	1	8
Strata	9	0	0
Stone Coal	0	2	6
Strata	31	1	6
Lower Two Yard Coal	2	0	0
Strata	27	1	6
Coal (very good quality)	0	2	0
Strata	25	0	0
Llwynenion Coal	0	1	8

Iron-stones.—The iron-stones of this coal-field have long been known for their richness and abundance, and are largely employed in

* For which the author is indebted to Mr. Napier, the manager. The above is somewhat abridged from the original.

† For which I am indebted to Mr. P. Higson, jun., of Manchester.

the Brymbo, Frood, and Ruabon Iron Works. They occur both as "clay-band" and "black-band" ores, and occur in the following positions:—In the upper beds, which lie between the upper and lower sulphurous coals, there are several bands, none of which, I believe, are worked. About 15 yards below the lower sulphurous coal there is a band 9 inches thick, and another 6 inches thick a little above the Drowsall Coal. Above the Brassy Coal, there are shales with several thick bands; and below it, several valuable bands which give the following section at Westminster Colliery:—

	Yds.	Ft.	In.
Brassy Coal	1	2	0
Bass	0	1	6
Clunch	1	1	9
Ironstone	0	0	3
Clunch	0	3	6
Ironstone	0	0	4
Shale	0	1	9
Ironstone	0	0	4
Shale	0	2	0
Ironstone	0	0	9
Shale	0	1	9

At 5 yards under these, are several more thick bands. The next, and perhaps most important, band, is the "Main Coal black-band ironstone," 18 inches thick, lying about 7 yards above the Main Coal. Many of these ironstones contain bi-valve shells. In Denbighshire, there are blast-furnaces at Ruabon, Plaskynaston, Plas Issa, Frood, Brymbo, Leeswood, Ponkey, Dolydd; in all fourteen, but of these only eight were in blast during the year 1860.

Resources.—The Denbighshire coal-field is far from being developed to the extent of which it is capable. In fact, we may affirm that, at least one-half of it, is practically unexplored; yet we have seen with what fine seams of coal and ironstone it is stored throughout. The collieries are generally placed in groups in certain districts; which may be stated in general terms to be—the north, the centre, and south of the field; but between these *foci*, there are considerable tracts with no collieries, at least until very recently. The construction of the Shrewsbury and Chester Railway has given an impetus to mining speculation, but not to the extent which might have been expected.

One reason to which this comparative neglect of mining operations may undoubtedly be traced is—the depth of the superficial drift which covers a large portion of the district, completely concealing the nature of the strata, even in deep river-channels. This is particularly the case to the west and north of Wrexham, and from the banks of the river Ceiriog to Oswestry. It consists, in this country, of a great accumulation of gravel, formed principally of fragments of rock derived from the neighbouring Welsh mountains. This sort of material forms a great impediment to sinking shafts, owing to the water it contains; and as it, moreover, renders the mineral character of the strata obscure, people are unwilling to risk capital upon doubtful investments.

The area of the Denbighshire coal-field is 47 square miles, and it originally contained 727 millions of tons of coal down to a depth of

3000 feet, of which, probably one-tenth has now been raised.* The production of coal is steadily, indeed rapidly, increasing—reaching, in the year 1860, 1,139,500 tons from 39 collieries, as against 527,000 tons in 1858.† Had it not been for the recent depression in trade, the amount raised would, in all probability, have reached a much higher figure. Even at this rate there is enough coal to last for upwards of 400 years.

As compared, therefore, with the Flintshire coal-field, the resources of this field are great indeed; for, notwithstanding the recent re-discovery of the cannel seam there, we may, with much confidence, assert that the coal-field of Flintshire will be exhausted in about half a century.

On the Mexican Method of Amalgamation.

BY JAMES NAPIER, JUN., F.C.S.,

Late Chemist and Assayer of the Guanaxuato Mint, Mexico.

§ V.—THEORY OF THE PROCESS.

HAVING now given a brief sketch of the mode in which the Mexican amalgamation is carried out, I shall pass on to consider what chemical action takes place in this most interesting process. Before doing so, however, let us consider for a moment two terms—*heat* and *cold*, used in these papers.

Heat and Cold.—There are two kinds of heat: one is caused by there being added a superabundance of magistral; the other is induced by cold, and is called "*calor de frio.*" These differ only in cause, the result in both cases being the destruction of mercury. If a *hot* torta be heated by artificial heat, the chloride of mercury will act on the sulphide of silver in the same manner as the chloride of copper, forming chloride of silver and sulphide of mercury.

On cold mornings the tentaduras, or samples, often show signs of heat, in which case the action is called *calor de frio*—heat from cold; but, as the day advances, and the sun begins to act on the torta, the effect passes off. In the winter season, a somewhat less quantity of magistral is necessary for carrying on the operation than in the summer months: the amalgamators begin to decrease the quantities of magistral about the beginning of September.

When a torta becomes hot from the use of a superabundance of material, a quantity of wood ashes or lime is added for the purpose of decomposing the excess of chloride of copper; and, as I have also before stated, copper precipitate is used for cooling a torta, which it effects by reducing the excess of bi-chloride of copper to proto-chloride.

The term *cold* simply implies that the operation is not going on so fast as it ought, and that a sufficient quantity of magistral has not been added; if the torta be allowed to remain long in this state, a large quantity of mercury is apt to be lost in the form of oxide.

Theories of the Process.—According to Sonneschmidt, the only theory which the Amalgamators had before his time was, that the

* *Coal-fields of Great Britain*, Second Edition, p. 101.

† *Mineral Statistics of Great Britain*, for those years respectively.

salt cleaned the silver, the magistral heated it, and that both reduced it to the metallic state so as to combine with the mercury. They were also aware that, for each ounce of silver produced there must be lost an equal weight of mercury; but *why* this should be so, was a problem they could not solve, and all mercury lost beyond this they considered mechanical.

Sonneschmidt's Theory.—Sonneschmidt after many years of practice and careful experiment, published a most valuable treatise on the various methods practised in Mexico for the reduction of silver ores, and lays down for the patio amalgamation his theory, which may be briefly stated as follows:—

The ingredients added to a torta, are salt, magistral (sulphate of copper), mercury, and sulphide of silver. The salt and magistral act on each other, and form a bi-chloride of copper and sulphate of soda; the bi-chloride of copper next acts on the sulphide of silver, forming chloride of silver, which is dissolved in the excess of salt added; and the silver is next reduced to the metallic state by the mercury forming calomel and amalgam. This was Sonneschmidt's theory, which to the present day is almost universally received as the true one. However, since his time it has been further shown, that the proto-chloride of copper, formed by the action of the sulphide of silver on the bi-chloride, is dissolved in the excess of common salt, and acts on another portion of the sulphide of silver, reducing it to the state of chloride to be acted on by the mercury, and be converted into amalgam. It has also been shown very satisfactorily by Boussingault, who has devoted some time to the subject, that the copper of the sulphate is ultimately converted into a sulphide by the following equation:—

$$Ag\,S + 2Cu\,Cl = Ag\,Cl + S + Cu_2\,Cl. \text{ then}$$
$$Ag\,S + Cu_2\,Cl = Ag\,Cl + Cu_2\,S.$$

Sulphide of mercury is also at times found in tortas, and it has been supposed that this is formed by the calomel acting on the sulphide of silver, giving chloride of silver and sulphide of mercury; but may it not be formed, as in the arrastres, by the direct action of the mercury on the sulphide of silver? Some amalgamators suppose that the copper is ultimately converted into oxychloride.

Bowring's Theory.—In 1848, Mr. John Bowring, who has had much practice in the patio amalgamation, as carried on in Mexico and Peru, read a paper before the British Association, in which he denied that chloride of silver was formed at all in the process. His principal reason was founded upon experiments made in *Guadalupe-y-Calvo*, in Mexico, where he states, chloride of silver could not be found even after leaving the tortas in the patio in working order for the space of four months. In 1858, Mr. Bowring also published a pamphlet in Mexico defending the same idea; and describing, as he likewise did in the paper mentioned, a new theory, the basis of which I translate from his pamphlet:—

"It is," he writes, "well known, that the materials which are employed in the reduction of the sulphides of silver, consist of salt, sulphate of copper, and mercury; and that, by employing only two of these ingredients, nothing will take place. I mixed the three in an appropriate vessel, and found that the mercury combined with half

of the chlorine contained in the bi-chloride of copper, and thus formed a proto-chloride of both metals. This combination of the latter metal—copper—has the property of absorbing oxygen; hence, we may suppose, that this element is the principal agent in the operation. I made some proto-chloride of copper, tried it in the patio, and obtained a good result.

"According to the theory which this mode of treatment establishes, the bi-chloride of copper gives an atom of its chlorine to the mercury, and both metals are converted into proto-chlorides; the chloride of copper absorbes oxygen, which combines with the sulphur of the silver, forming sulphuric acid, and leaves the silver in a metallic state to amalgamate.

"The sulphuric acid formed by the sulphur of the silver and the oxygen of the proto-chloride of copper, decomposes the common salt, and the chlorine disengaged in this way may combine in either of the two following methods:—1st. With the protochloride to form again a bi-chloride. 2nd. With the chloride of the protoxide of copper, which, absorbing another equivalent of oxygen, passes to the state of oxychloride, or chloride of the peroxide. According to my mode of thinking, the protochloride of copper produces in the beneficio (amalgamation) an effect analogous to nitrous acid in the manufacture of sulphuric acid. It is easy to imagine that the protochloride of copper, after it has absorbed oxygen from the air and water, and given it up to the sulphur, will return to repeat the same operation."

Mr. Bowring then gives the following proofs of his theory:—

"I. Dissolve, in a glass or porcelain vessel, salt and a small quantity of sulphate of copper, with this mix some mercury, and at the end of a few hours there will result a white powder which is protochloride of mercury: filter the solution, and precipitate the copper with caustic soda or potash. The orange colour indicates a salt of the prot-oxide; and if care be taken to gather on a filter the white powder, it will, in contact with caustic soda and ammonia, be converted into the prot-oxide of mercury, which may be known from the black colour it assumes. If the solution of proto-chloride of copper be left exposed to the air for a longer time, there will form on the surface a yellowish green crust, which is a chloride of the prot-oxide of copper.

"II. Beneficiate (amalgamate) a small quantity of ore, containing sulphide of silver, with salt, and bi-chloride of copper chemically pure; at the conclusion of the operation add distilled water; filter, and precipitate the solution with nitrate of baryta; when it will be found, that there has been a formation of sulphuric acid equivalent to the sulphur which was combined with the silver. It is to be noted that this sulphuric acid could not have been formed without the presence of oxygen, which, without doubt, resulted from the absorption of this gas by the proto-chloride of copper.

"III. Amalgamate silver ore with bichromate of potash and sulphuric acid (it is known that the chemical action of these two latter on each other is to evolve oxygen), and it will be found that there is formed an amalgam of silver. In the same way, any materials which produce oxygen may serve in the amalgamation.

"IV. Take the amalgam of a tentadura (sample) of a torta which

is in good working order, that is in such a condition that when the amalgam is pressed with the finger it gives out a white powder; dissolve this in pure nitric acid, and wash afterwards with distilled water, when it will be found that the white powder which remains is a protochloride of mercury." Again, in the same pamphlet, Mr. Bowring states: "The difficulty there is in working ores containing chloride of silver (like those from the district of *Catorce*) demonstrates clearly the nonfoundation of the formation of chloride of silver in the common patio amalgamation." Thus, we have Mr. Bowring's reason for rejecting the theory of Sonneschmidt, and denying that chloride of silver is formed, and also the theory of his own which he proposes to substitute.

Uslar's Experiments.—In 1853, Dr. Uslar published a pamphlet in Mexico, comparing the patio with the barrel amalgamation, in which he, like Mr. Bowring, denies that chloride of silver is formed in the patio. He argues, that if the silver were converted into chloride, some other metal, such as copper, might be substituted for the mercury until the whole of the silver was reduced to the metallic state; and he instituted experiments to prove that such would not answer. Thus he introduced into a torta a superabundance of materials—salt and sulphate of copper, and some metallic copper. The result obtained was, no silver reduced, and the conversion of the greater part of the metallic copper into chloride. The next experiments were made with a view of protecting the mercury by copper or iron. The results were:—where iron was used, there was no amalgamation at all, the mercury coming out as it went in, without amalgam; but, where copper was present, the result was different, the amalgam containing a large quantity of copper with but little silver. The conclusion drawn by Dr. Uslar from the above experiments was, that the presence of other metals is against the amalgamation.

In a third series of experiments, there was put into the torta double the usual quantity of salt; in two days afterwards the magistral was added, and the whole trodden at intervals during fifteen days. Then iron was added, and the mass again trodden; and two days after this the mercury was added; but the torta showed no symptoms of entering into amalgamation, and after remaining eight days longer in the patio, and being trodden daily, the mercury was taken out as it was put in, without amalgam. Hence, Dr. Uslar comes to the conclusion that it is not true that chloride of silver is formed by the salt and sulphate of copper, and reduced by the mercury; because, with the extra quantity of materials, chloride of silver ought to have been formed,—the iron ought to have reduced it more rapidly than the mercury, and amalgam ought to have been formed; but nothing of the kind took place. He also argues, that as ores, containing native chloride of silver, cannot be worked by the patio amalgamation, it therefore cannot be *formed* by it. However, Dr. Uslar, unlike Mr. Bowring, proposes no new theory.

Consideration of the Theories.—Having now stated the various opinions generally entertained regarding the theory of this process, I shall venture a few remarks which may not prove altogether uninteresting, and may help to throw some further light on the subject.

An apparently very strong argument used by Bowring and Uslar against chloride of silver being formed in the patio amalgamation is, that native chloride of silver, according to them, cannot be worked by that process. This might even be quite true, and yet chloride of silver be *formed* in the process; for we have only to consider the physical properties of the native chloride, to take a different view of the matter. It is a very hard horny substance, which, even in ammonia—probably its best solvent—will take some time to dissolve. Now, in a torta, the solution of salt is comparatively weak; it is also cold, and will dissolve but a very small portion of the newly-formed chloride; but of native chloride (or horn silver), I question much whether the usual strength of the salt in a torta would be strong enough to dissolve *any*. Mr. Edward Louckner* has often assured me that horn silver can be reduced very well, in fact, better than any other compound, in the patio, providing that great care be taken in the grinding, so as to have it in the smallest possible state of division, and that an excess of salt be added in the operation.

Another argument used by Dr. Uslar, to prove that chloride of silver is not formed in a torta is, that if such were the case, it ought to be precipitated or reduced by another metal, such as copper, or iron, previous to adding the mercury.

Now, metallic silver can be produced from the sulphide by various methods; but there is a great difference in the ease with which silver produced by such different methods will combine with mercury. If, for instance, metallic copper, in the form of precipitate, with a little salt as an exciting agent, be added to an ore containing sulphide of silver, metallic silver and sulphide of copper will be the result. This result will be more or less perfect, according to the conditions under which the experiment is made. If the ingredients be ground in a mortar, the result will be rapid; but if mercury be now put with this, it will form amalgam but very slowly indeed, unless heavy friction be used. On the other hand, native silver, and metallic silver, formed by precipitation from the sulphate by copper, or by many other means, will amalgamate with greater ease; so that the silver in Dr. Uslar's experiments might actually have been reduced to the metallic state, but would not amalgamate in the torta; and such probably was the case. I have repeated these very experiments of Dr. Uslar on a smaller scale; that is to say, I took the usual proportions of salt and sulphate of copper, and mixed with them moderately rich silver ore. After these had remained in contact for about twelve hours—part of the time exposed to a tropical sun—the experiment was divided into two portions; to one was added a small

* Mr. Louckner, whom I have before had occasion to mention in these pages, was a gentleman of the highest scientific attainments, and had studied closely, for upwards of thirty years, every thing connected with the reduction of silver ores in Mexico. He had also written what, I have no hesitation in saying, would have been the most valuable treatise which has yet appeared on the subject, but which, I regret to state, is lost to the world. In 1855, Mr. Louckner was travelling from Angangueo to Guanaxuato, having with him his MSS. At a certain part of the road he was attacked by robbers; and, on attempting to defend himself, his pistols missed fire. He was then overpowered, robbed, severely wounded, and left on the highway for dead. When he recovered himself, he found his papers and MSS. torn and scattered to the winds. Mr. Louckner died four and a-half years afterwards in Guanaxuato.

slip of very bright etallic mcopper, and to the other a piece of polished iron. Almost the moment the copper was added, it became coated with a white precipitate of silver; silver was also precipitated on the iron, but not until it had been in contact for some time. Again, if we take into consideration the small proportion of metallic silver there is in a torta, compared to the enormous amount of earthy matters present; and also the small amount of mercury, and that the two metals would have to be brought into actual contact before they could combine; it would, I think, have been rather strange had amalgam been formed. It is not enough that silver and mercury be brought in contact with each other to make them combine; but, in many cases, it requires heavy friction; and in a thick pasty mass like a torta, the difficulties would be much increased. When the chloride of silver is in solution in common salt, then we have a chemical action going on by which we can better understand why amalgamation takes place.

The next argument used against the formation of chloride of silver is founded on the fact, that it had failed to be detected in tortas which had been left in the patio for months, without mercury I presume. The following experiments made by myself may entirely account for this:—

The first experiment was on pure sulphide of silver. To this was added a small portion of bi-chloride of copper and salt, and the result was an abundant formation of chloride of silver.

The next experiment was made with common silver ore of moderate richness, which, besides sulphide of silver, contained also sulphides of iron. To this were added the usual quantities of sulphate of copper and salt, and the result was, that chloride of silver was formed after a few hours' standing; but, at the end of three days, I was surprised to find that the whole of the chloride of silver had again disappeared. The experiment was prolonged for three weeks, and tested daily for chloride of silver, thinking it might reappear; but it did not. This experiment was repeated at various times, and with different ores; and in every case chloride of silver was formed, but in some instances only did it disappear on standing. I may here observe that the chloride of silver held in solution at one time in a torta must necessarily be very small, from the fact that the quantity of salt *used* is only sufficient to hold a very small quantity in solution at once; so that in making such experiments as the above—unless the ores used be very rich, and a large excess of salt be added—one must not expect to obtain an abundant formation of chloride, but rest contented with finding a moderate proportion, as the process is one which goes on but very slowly indeed.

It became a question why the chloride of silver, when once formed, disappeared again? This I tried to discover by numerous experiments on a small scale. In tortas, where large quantities of sulphide of iron, particularly of the white variety, was present, the chloride of silver was decomposed, and chloride of iron formed; the silver being again probably converted into sulphide.* Sulphides of copper had no action on chloride of silver. Where galena was pre-

* With artificial sulphide of iron, chloride of silver is very rapidly decomposed, particularly when heated.

sent, the chloride of silver was very rapidly decomposed, and chloride of lead formed. Blende had a similar effect; and this may explain why in *Zacatecas*, and some other districts where the ores contain blende, and sometimes small quantities of galena, they are obliged to use an excess of magistral for the purpose of first decomposing these sulphides. We are also aware that if sulphate of copper and salt be added to galena or blende, that chlorides of lead or zinc would be formed; and there are, doubtless, many local actions taking place in tortas, which may vary very much with the nature of the ores operated upon. I have withheld many experiments made on a small scale on the subject; believing that it is only by close attention to the many various changes which take place in the tortas themselves, that a true knowledge of the theory of the patio amalgamation can be arrived at, and that laboratory experiments often only tend to lead us astray, unless corroborated by actual results on a large scale.

To prove further the formation of chloride of silver in the operation, I have obtained numerous samples of tortas in actual operation, after the salt and magistral had been added, but before the addition of the mercury. In every case did I find chloride of silver; and even when the mercury was present, in tortas far advanced, chloride of silver was always found. My general method of testing was to digest the sample for a short time in a solution of hot common salt; then filter, and add to the filtrate a clean piece of copper, upon which the silver was precipitated. In some cases the sample was digested in weak ammonia, filtered, and an acid added to the filtrate, which precipitated the chloride of silver.

From what has been said, it is very evident that, at the commencement of the amalgamation, there must be a considerable quantity of free chloride of copper present; because the whole of the ingredients necessary to carry on the operation to the end are added at once, and yet the torta does not become *hot*—provided of course the ingredients have not been added in excess. How is this? The only answer I can give is, that the patio amalgamation is founded on the affinity existing between sulphide of silver and chloride of copper, and that if the torta became *hot* at the commencement, when an excess of materials were not added, then we would have no such process as the patio.

When a torta is *very* hot, amalgamation does not go on nearly so rapidly as at other times. This may be owing to the mercury becoming covered with a coating of chloride, thus preventing the chloride of silver from being reduced.

Now, according to Mr. Bowring's theory, that the first action which takes place is the conversion of part of the mercury into chloride, the torta ought to become hot at the very commencement, whereas such is not the case; and to avoid loss of mercury in this way, Mr. Bowring proposes, and has patented, the use of protochloride of copper instead of magistral.

Faults, Dislocations, and Disturbances in Coal Mines.

By Mark Fryar, F.G.S.,
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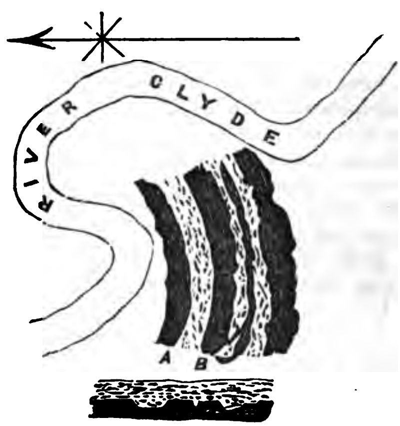
(*Continued from page* 345.)

The "want" is an irregularity in coal-beds of not unfrequent occurrence. A rather notable example is shown in fig. 3. The distance from A to B is about fifty-five yards, and the space is filled up with the kind of sandstone rock which forms the roof of the coal-seam. On the north side of the "want" the coal-bed is of its regular thickness, but southwards it is very much broken and mixed with sandstone over a width of more than one hundred yards. In some places the seam is more than double its usual thickness, and in others it is "nipped out" to the thinness of an inch, or the seam or bed is divided into upper or lower coal, and separated by a thin sandstone bed. This "want" is remarkable as following, with some degree of conformity the bed of the Clyde, as far as the workings of the Old Farme Pit have exposed it, a distance of about 330 yards.

Fig. 3.



In a pit some distance to the west of the Old Farme it has been met with, and is shown there to be very tortuous although deviating considerably from the course of the Clyde. The coal-seam in which it occurs is about 30 fathoms below the surface at the place shown by the drawing, but more than half of this cover consists of diluvium.* It is, perhaps, too great a stretch to suppose that the river Clyde is the stream by which the coal has been denuded from these spaces in the coal-seam, and that its bed is now 30 fathoms above its ancient level, or even that this ancient level has been sunk to that depth; the conformity of the ancient and modern river beds is however some-

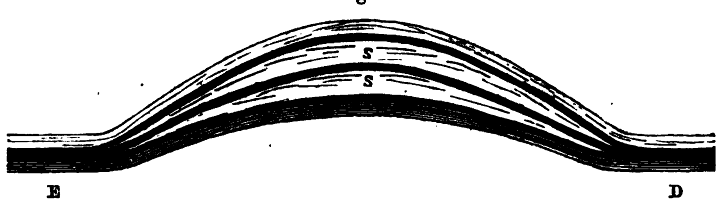
* For particulars relating to this "want," I am indebted to Mr. J. Anderson of Old Farme Colliery.

what striking. For the practical lessons to be derived from a study of this kind of irregularity in coal deposits, it is sufficient to know that they are the result of denudation after the formation of the coal-bed, and of subsequent filling up with the shale or other kind of rock by which the roof of the coal has been formed.

In the Memoirs of the Geological Survey—the South Staffordshire Coal-field, by J. B. Jukes, F.R.S.—it is shown that the Staffordshire thick-coal, which is about thirty feet in thickness, south of Bilston, is in reality made up of twelve or fourteen separate coal-seams; and that these seams, although they are so close together in places south of Bilston and towards Dudley as to give them the appearance of one very thick coal-bed, are nevertheless, in more northerly parts of the coal-field, as at Bentley, Wyrley, Pelsall, and Essington, worked at from five to fifteen or twenty fathoms apart. Mr. Jukes very properly observes, "It may well be doubted, whether any single bed of coal is even more than two or three feet in thickness, and we may therefore take it for granted, that every bed which exceeds that thickness, over any considerable space, is in reality a compound seam, made up of two or more beds resting on each other, with or without 'partings' of shale, &c., between them."

Instances of this kind of separation in coal-beds are to be met with in the majority of coal-fields, and many examples might be given of coal-seams being sufficiently near to each other in one part of a very limited colliery district, to be worked together as one seam; whilst in other parts of the same district they are divided by several fathoms of coal-measures strata. The most remarkable phenomenon of this kind which I have been made acquainted with is shown by fig. 4.

Fig. 4.



The following particulars respecting it have been supplied by Mr. Stewart, of Bristol, who for many years followed the profession of mining engineer to the coal mining districts near Swansea. The distance from D to E is not more than 80 yards; the "partings" S S consist of fine blue shale, and have a maximum thickness of 10 feet each: the three small coal seams separated from each other, are each two feet in thickness, and on each side, as at D and E, they come closely together without partings, and form a 6 feet coal bed. How far these conditions may have been maintained through a distance transversely to this section is not known, as it was to be seen in a perpendicular cliff 200 feet high, where the coal-measures throughout the distance shown by the section were laid bare.

"Swells," or "rolls," and "nips," are names given to a rising up in the floor of a coal bed, and where the roof and floor both swell out, so as to reduce the thickness of the bed. "Balk" is a name applied by the colliers of Newcastle, to the "want" illustrated by

fig. 8. "Check" is just another name for a dislocation; and "Vs" is a very convenient, and not inappropriate expression for the plane of fracture, where a displacement of the beds has taken place.

The study of faults is one fraught with interest to the geologist; but to the mining engineer, it is even more so, for, upon a due knowledge of the phenomena are depending, at this moment, the pecuniary success or ruin, or at least serious embarrassment, of many mining enterprises; and to this we may add, the reputation of the engineer, and the lives of the workmen. The Cockfield-fell-dyke, already noticed, may be cited as an example of many instances to be met with, of the effect of such faults on the water contained in the strata contiguous to mining works. On each side of this dyke, and between its vertical faces and the adjacent rocks, there occurs about six inches of strong clay, by which the dyke is rendered so completely impervious as to dam back the water of the country for miles in the direction of the fault. I know the case of a colliery, where a trial shaft having been sunk to a considerable depth, entailed a very serious outlay, and resulted in abandonment and heavy loss, owing to the large feeders of water met with. After the abandonment of this unsuccessful trial, another site for sinking was fixed upon but a short distance from the first shaft, but on the opposite side of a dyke; here a most successful "winning" was accomplished without (in sinkers' language) "a drop of water being met with." In deciding upon the place for "dams" in a pit, and estimating the efficiency of barriers of either coal or stone, the probable existence, and the number, direction, and character of faults, require careful attention. The amount and direction of the hade or dip of faults, and the probable accompanying branches or strings of a main slip or dyke, are also points of serious importance.

Illustrated Notes on Prominent Mines.

By the Editor.

EAST CARN BREA AND WHEAL UNY.

The wood-cut (figure 1) on the opposite page, shows a section of the country and workings on the run of the lodes which traverse these mines, drawn on the scale of 190 fathoms to one inch. The principal workings at East Carn Brea and Wheal Uny are shown, and also the depth of the old engine-shafts at Wheal Sparnon and East Sparnon: the latter mines not being now at work, it would be troublesome to ascertain accurately the extent to which the levels are driven, and consequently they are omitted in the section. We have already, in No. I (page 47), given a section of the workings at East Carn Brea on a larger scale: the present section is purposely drawn on a small scale in order to show the geological position of these mines, occupying a killas basin between the ranges of granite. It may also be well to remark, that the Carn Brea granite range, which in the section is shown as ending on the surface about Redruth Church, extends further east as we come south of the line of section, and consequently

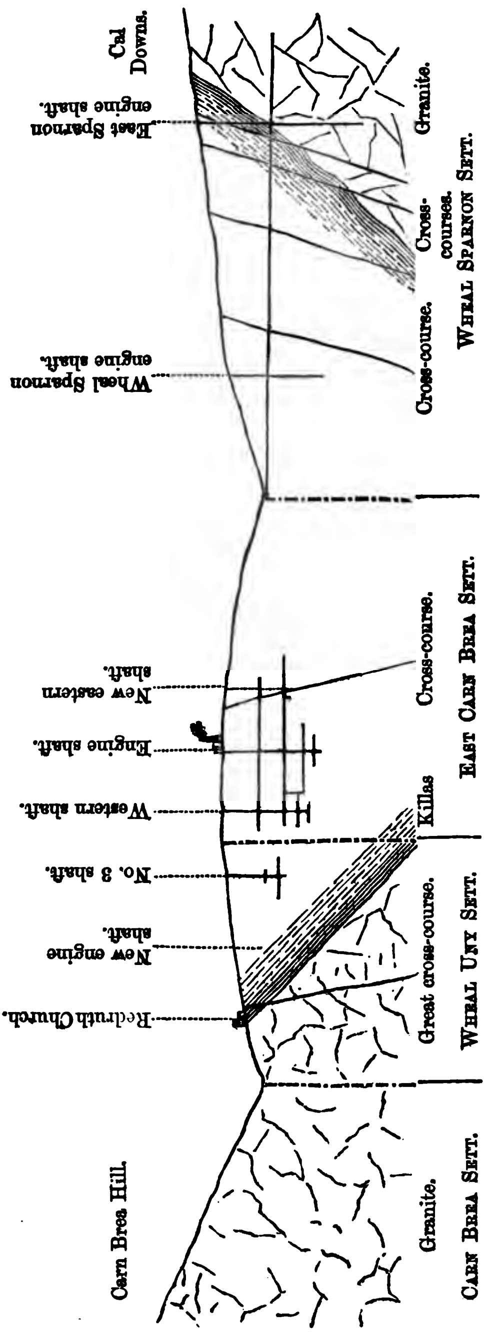


FIG. 1.

SECTION ALONG THE LINE OF EAST CARN BREA, WHEAL UNY, WHEAL SPARNON, AND EAST WHEAL SPARNON.

Scale, 190 fathoms to an inch.

flanks the East Carn Brea lodes through a great portion of the length of their sett—giving that mine a geological position similar to that of its great neighbours (Carn Brea, Tincroft, Cook's Kitchen, and Dolcoath) further west.

East Carn Brea, is worked to a depth of 50 fathoms below the adit, the *engine-shaft* being sunk perpendicular to the adit, and below that on the course of the lode: the levels are the adit, the 26, the 40, and the 50—all shown in the section extending from the engine-shaft. The *adit*, which was driven by the "old men," and used to be called the "silver adit," comes up from near Messrs. Magor's brewery, to the south of Redruth, under the "west end" of that town, gaining 20 fathoms of backs at the engine-shaft. The other shafts shown in the section are:—the *western shaft*, about 60 fathoms west of the engine-shaft and within 30 fathoms of the western boundary, sunk perpendicular to the 40; and the *new shaft*, to be sunk perpendicular to the 26, down 17 fathoms below the surface, and raised up against 4 fathoms from the 26; the dotted line shows the course upon which this shaft will be sunk. It may be well to remark, that the levels driven from the western shaft under the 26, called the 30 and 40, are respectively within 3 fathoms of being as deep as the 40 and 50 from the engine-shaft.

Three lodes have already been opened on in East Carn Brea, all underlying north about 2 feet in a fathom, that is, dipping away with the granite. On the northernmost, called the engine lode, the engine-shaft has been sunk; to the south of this 11 fathoms (at the 50) is the middle lode, and 25 fathoms at the same level, the south lode. Of these, the most important is the south lode, on which a splendid run of ore-ground has been opened out, which makes East Carn Brea one of the most promising young mines in the county. In consequence of the engine-shaft being sunk on the engine lode, the south lode has hitherto had to be explored by cross-cuts, which is always a disadvantage; the western shaft, however, comes down on this lode, and the new eastern-shaft will also be sunk on it below the 26. A little to the west of this new shaft the cross-course is shown, and just to the west of this the winze sinking below the 26, which has gone down in a splendid course of ore: the shaft, on the other side of the cross-course will also go down in a beautiful course of ore.

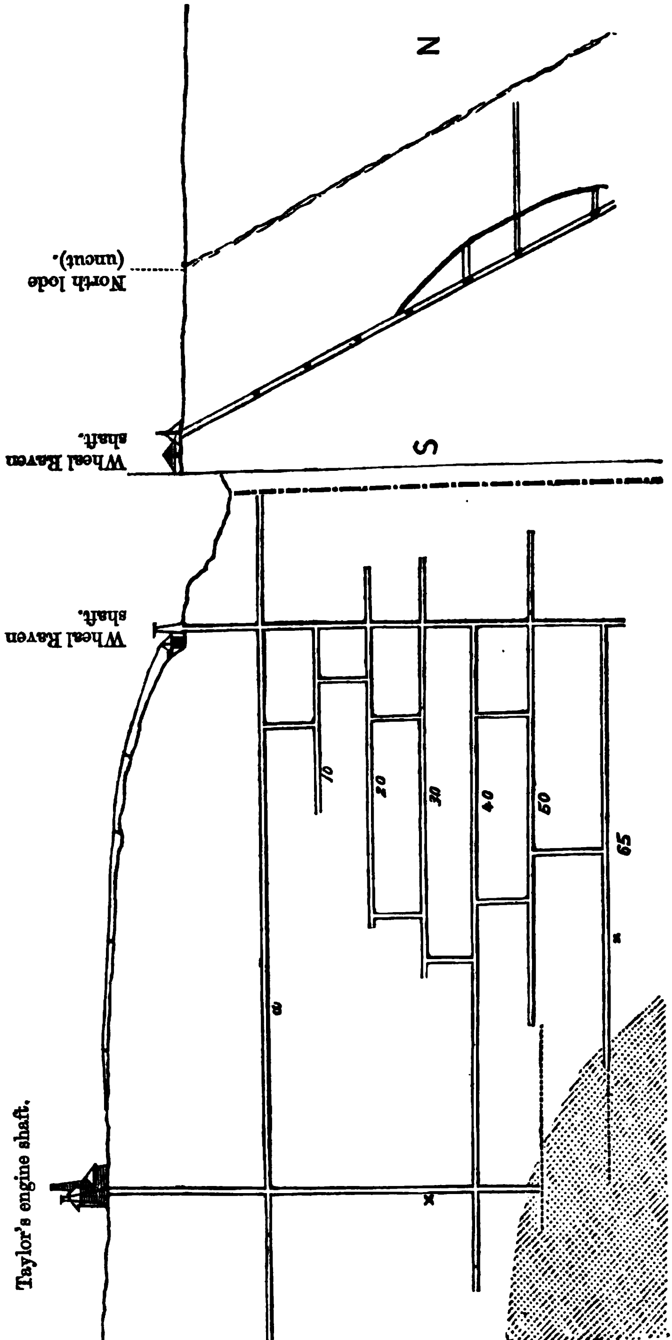
Besides the lodes already opened on, there is in this sett another lode to the north, supposed by some to be the lode worked on in Wheal Sparnon—although others maintain that the south lode is the Sparnon lode. There has been a cross-cut driven to intersect this at the 50, but the end—in which a stone of ore has been cut—let down such quantities of water that it had to be stopped for the present. There are also other lodes to the south, in the tongue of granite which I have said extends east from Redruth church, flanking the south lodes, the chief of which are: the lode called No. 2 lode, in Uny, and the Wheal Uny tin lode, and Davies's lode.—The cross-course shown in the section, disturbs the lodes in rather a remarkable manner—some of the lodes, at the same levels being heaved considerably, while others are very little disturbed. On the whole, however, the lodes are not much disturbed in their course—for if one branch of a cross-course heaves them considerably, another branch is generally found throwing them back again.

Fig. 2.

Sections of West Tolgus Mine, Illogan, Cornwall.

Scale, 35 fathoms to an inch.

Longitudinal Section. *Transverse Section at Wheal Raven Shaft.*



Wheal Uny is principally worked for tin, on a lode considerably south of those now wrought in East Carn Brea. It is a very remarkable lode, as it is found, for a great length of its course, dipping south with the junction of the killas and granite, very large, and producing vast quantities of low class tin stuff. We shall not dwell upon this lode at present, as we propose giving some illustrations of it in an early number. The other workings in Wheal Uny are on the East Carn Brea south lode, which has been opened out on from a shaft sunk within 35 fathoms of the boundary, called No. 3 shaft, now down perpendicular to the 58, and which will take the lode at the 70. From this, levels have been opened out at the 37 and 48, and some good ore-ground met with. This shaft, however, will not be the engine-shaft, another having been pitched for that purpose, 70 fathoms further west, which will take the lode at the 48: it is now down about 10 fathoms, and is sinking by nine men. The great cross-course, which breaks up the valley under Carn Brea Hill, and which can be traced through all the Tolgus mines to the north, traverses this sett, passing about under the church: the Carn Brea south lode also passes under the church, so that at this point they will form a junction.

WEST TOLGUS.

The wood-cut figure 2, shows two sections, on a scale of 35 fathoms to an inch, of this mine—one, a longitudinal section on the course of the lode explored, and the other, a transverse section at Wheal Raven Shaft. This mine is on the same run of lodes as the old Tolgus mine, from which it is separated by the valley shown in the section.

The old workings are prosecuted from the eastern (Wheal Raven) shaft, which had been sunk to a little below the 65 under adit. The levels from this—the adit, the 10, the 20, the 30, the 40, the 50, and the 65—are all shown in the section. Almost all these levels were driven in the former working, except the 65, which had only been driven as far west from Wheal Raven shaft, as the point marked with a cross (×). Since the mine has been re-worked, this level has been extĕnded about 20 fathoms, and the fine bunch of ore, shown by a dotted space in the section, met with.

There had also been an old whim-shaft sunk on the lode just at the point where Taylor's engine-shaft is now put down. This had been sunk as far as the point marked with a cross (×); so that, both at this shaft and in the 65 fathom-level, the old workers were within about 20 fathoms of the ore ground. The present (Taylor's) engine-shaft is an entirely new one, sunk perpendicular to adit, and below on the course of the lode, where, in the present bottom, the ore ground has also been met with.

The present working of West Tolgus was commenced about two years ago by Messrs. John Taylor and Sons, under the management of Captain Joseph Jewell. The mine had to be forked through the old Wheal Raven shaft; but now the water from the bottom level is raised in that shaft (by a 12-inch box) to the 40, where it goes back to a 14-inch pole at Taylor's shaft. The 65 end is now about 24 fathoms from the shaft, to which it is expected to hole in six or seven

months, when all further pumping through Wheal Raven-shaft will be dispensed with.

Besides the main (or south) lode, another lode is known to exist to the north, to which a cross-cut is being extended at the 50. This lode and cross-cut is shown in the Transverse section. Another lode, called the *north branch*, has also been cut in the 40, 50, and 65 fathom-levels. Going upwards, it falls, as shown in the section, into the south lode, and in depth it also seems to be bending back towards it.

We give a drawing in Plate IV., of an arrangement adopted at this mine by Captain Jewell, for breaking the underlie of the pump-rod in the shaft. It is found to work admirably here and at South Tolgus, and is a great saving of cost, as it dispenses with the necessity of cutting ground for a bob-plat.

Abstracts and Reviews.

MINERAL INDUSTRY OF THE AUSTRIAN EMPIRE.

(From the *Revue Universelle,* abstracted from Friese's Memoir in the *Zeitschrift des æst. Ingenieur-Vereines.*)

THE law of January, 1854, which put a limit to the exaggerated demands of landed proprietors, coupled with the rapid extension of railways, and the spirit of industrial energy, and of association which is everywhere evident, have given such an impulsion to the mineral industry of Austria as to cause a complete transformation within a few years. This continually increasing prosperity of the mineral industry of the empire shows that there was only required, for its development, a due regulation of its rights and burdens.

EXTENT OF CONCESSIONS.—According to official returns*, the mineral concessions at the end of 1859 comprised 301,244,313 square *klafters*, or about 266,000 acres. This does not include salt-works, which are worked without concessions. The accompanying table shows the manner in which these are distributed throughout the different mining districts of the empire, and the proportion of the empire of each wrought for the various mineral products.

In regarding the various provinces of the empire, we see that the working of iron as well as of coal preponderates in the countries in the region of the Alps. The group of miscellaneous minerals, which principally comprise mines of lead and mercury, also occupies a considerable surface in this district; but, on the other hand, the working of gold and silver is here insignificant.

In Bohemia the coal-workings occupy more than three-fourths of the sur-surface conceded; and they exceed in extent that of the collieries of all the rest of the empire. The iron-ores are almost as considerable as in the preceding district. The noble metals are also worked to a considerable extent, while the mines of miscellaneous minerals are scarcely represented: the gold and silver mines of Bohemia occupy about a fifth part of the total surface wrought for these metals in the Austrian States.

The working of coal also preponderates in Moravia, Silesia, and Western Gallicia: it is the same with iron, but in a less degree. As to Eastern Gallicia and Bukowine, the workings there are very restricted.

* The title of the official returns of the Austrian Government is *Uebersicht der Verhältnisse und Ergebnisse des Oesterreichischen Bergbaues im Verwaltungs Jahre*, 1859. A very full abstract of these is given in Vol. xix of the *Annales des Mines.*

TABLE SHOWING THE EXTENT OF SURFACE CONCEDED IN THE DIFFERENT PROVINCES, 1859.

Provinces.	Mining Districts.	Underground Workings. Gold and Silver.	Iron Ore.	Carbonaceous Minerals.	Other Minerals.	Open Workings.	Total Surface.
		Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Austria (Upper)....	St. Pölten ..	..	2,020	8,724	359	..	11,104
„ (Lower)	„	..	56	9,489	22	..	9,569
Styria	Leoben	46	2,198	2,090	636	..	4,971
„	Cilly	156	914	10,349	190	..	11,608
Carinthia..........	Klagenfurt..	45	2,355	1,617	6,970	120	11,105
Carniola	Laybach ...	..	4,312	2,173	569	3,401	10,477
Coasts of Adriatic ..	„	22	..	203	110	..	380
Tyrol	Hall	67	926	1,574	1,373	747	5,054
Salzburg	„	435	494	..	335	85	988
	Total	771	13,274	36,220	10,563	4,353	54,778
Bohemia	Pilsen	67	3,781	16,185	2,084	67	22,185
„	Elbogen....	2,833	1,424	12,834	1,039	146	18,276
„	Kommotau	473	348	27,430	357	172	28,781
„	Küttenberg	279	2,358	9,606	2,561	23	14,827
„	Prague	1,242	4,906	13,426	459	..	20,034
	Total	4,894	12,817	79,481	6,501	409	104,102
Moravia	Olmutz	11	7,756	6,085	560	3	14,416
Silesia	„	167	2,471	4,738	45	..	7,422
Gallicia (Cracow) ..	Cracow	..	6,695	25,979	4,661	80	37,415
„ (Lemberg)..	Lemberg ..	..	480	900	..	278	1,658
Bukowine	„	22	78	..	67	81	248
	Total	201	17,480	37,703	5,333	442	61,159
Hungary (Ofen)....	Ofen	370	222	..	132	..	723
„ (Oldenburg) ..	„	..	585	89	45	..	719
„ (Presburg) ...	Neusohl....	13,665	1,222	89	1,299	50	16,327
„ (Kaschaw)....	Kaschau ...	334	2,559	..	1,751	253	4,898
„ (Grosswardein)	Nagybania..	2,404	285	..	138	..	2,827
	Total	16,773	4,873	178	3,366	303	25,494
Voïvodia	Oravicza ...	20	1,542	..	1,213	3	2,777
Transylvania (Siebenbürgen)	Zalathna ..	2,099	404	547	130	349	3,575
Croatia and Slavonia	Agram	..	201	758	67	1,434	2,460
Mil. Frontier Croatia	„	..	312	..	881	345	1,538
„ „ Banat	Oravicza ..	..	371	..	202	156	730
	Total	2,119	2,830	1,305	2,494	2,332	11,080
Venetia	Bellune	..	..	179	190	..	369
Dalmatia..........	Zara	..	..	89	390	..	479
	Total	..	..	268	580	..	848
General Total......	..	24,748	51,275	153,378	28,837	7,840	266,088

The greatest extent of gold and silver mines is found in Hungary and the Siebenbürgen—that is, about four-fifths of the total extent of these mines in the entire empire. In Hungary it is especially in the mineral districts of Kaschau and of Neusohl, that we find iron-mines and mines of miscellaneous minerals (principally copper); the working of coal, on the contrary, as in the Siebenbürgen and Voïvodia, has but a limited extension; probably, because before 1859 the right of extension belonged to the proprietor of the soil.

It will be seen that but a very restricted extent of surface is wrought in Venetia, and likewise in Dalmatia.

Arranging the different states of the empire according to the extent of surface conceded, we have them in the following order, the figures indicating the number of acres conceded:—

Bohemia	104,102	Transylvania (Siebenbürgen)	3,575
Western Gallicia	37,415	Voïvodia	2,777
Hungary	25,494	Croatia and Slavonia	2,460
Styria	16,579	Military Frontier	2,268
Moravia	14,416	Eastern Gallicia	1,658
Carinthia	11,105	Salzburg	988
Upper Austria	11,104	Dalmatia	479
Carniola	10,477	Venetia	369
Lower Austria	9,569	Coasts of Adriatic	380
Silesia	7,422	Bukowine	248
Tyrol	5,054		

Of the entire surface conceded, 7,840 acres are worked open-cast (*Tagmassen*), which only extends to the depth of the solid rock; and the remainder, about 258,240 acres, is wrought by underground works (*Grubenmassen*), which may extend to any depth. The State works by itself, or with partners, about 18°/o of the entire surface conceded, the remaining 82°/o being abandoned to private enterprise. About half the surface worked—whether by the State or private enterprise—is wrought for coal; of the other moiety of the surface worked by the State, the greater proportion is wrought for the precious metals.

After concessions—that is, existing properties,—we turn to those which may be future properties, for which exploring licenses have been granted in great numbers. These evidence, even more than the concessions themselves, the energy with which Austria, far from remaining stationary, is preparing new fields of industry.

In order to be declared the discoverer or *concessionnaire* of a mine, it is requisite, in the first place, to have received a license by virtue of which all the necessary explorations can be made within a radius of 224 *klafters* (about 45 acres). At the end of 1859, the number of these licences was 15,616, extending over a surface of 2,188,320 acres. Of all the provinces of the Crown, Bohemia is the most sought after in this respect, 4,419 licences having been issued. Hungary comes next with 3,187. Moravia and Silesia number 2,293; Western Gallicia 1,822; the region of the Alps 1,688, and the Banat 820.

These figures show the ratio between the extent of surface, conceded, and that under licence at about 1 : 8·2—that is, there is eight times more surface under exploration than under absolute working, a state of things showing a marvellous amount of speculative enterprise. Compared with the total surface of the empire, which we may take at 1,000,000,—the proportion conceded and under licence for exploration is as follows:—

1,675 conceded.
13,687 under licence for exploration.

15,362, or about 5·17°/o of the empire.

If we consider the various provinces separately, we find they vary widely. Venetia presents a *minimum* of surface conceded; while Bohemia—especially the districts of Brüx (Kommotau), Elbogen, Prague, and Pilsen—show a *maximum*. These last-named districts, with Silesia, Eastern Gallicia, and Moravia, have received the greater number of licences; the district of Elbogen presenting the *maximum*, licences having been given for explorations over 1·2°/o of its surface. It is worthy of remark that the number of these exploring licences are in the greatest proportion in the eastern parts of the empire, where the spirit of speculative enterprise seems to be most in the ascendant.

Compared with France and Belgium, we have the following:—As to the *extent* of surface conceded, while Austria only shows 0·17°/o, France has 0·9°/o of its surface under concession, and Belgium 5·7°/o. With regard to the *number* of concessions, in Belgium they reach 293, in France 462, while in Austria they amount to about 1,300. So that the relative area of each concession in these countries would be,—

Austria 100; Belgium 960; France 230.

This shows, at a glance, the great fault of the Austrian system, which is the indefinite multiplication of insignificant enterprises, such as can rarely be expected to produce important or durable results. This is pushed to such an extent in some provinces, as in Transylvania, for example, that many works are wrought exclusively by the members of the family of the proprietor.

Comparing the concessions existing in 1859 with those of the three previous years, we find that they have increased, in the case of iron ores, $16\frac{2}{3}$°/o; in the case of coal, $13\frac{1}{3}$°/o; and in the case of various minerals, $11\frac{1}{3}$°/o. During the same period, the extent of surface worked for the noble metals, decreased by $8\frac{2}{3}$°/o, which may be attributed, in a great degree, to the abandonment of certain mines nearly exhausted, or holding out little prospects of success, on the introduction of the mining taxes of 1855. But, as this cause has similarly affected coal and iron, the result seems rather to be due to the prevailing spirit of Austrian enterprise, which appears principally to direct itself towards the development of those mineral resources which form the bases of industry, and which seems to have recognised that there, as elsewhere, a coal-mine is better than a gold-mine.

PRODUCTION OF THE AUSTRIAN MINES.—No other nation produces such a variety of mineral products as Austria. By the side of gold and silver, we have the various species of carboniferous minerals, and a considerable production of copper, lead, mercury, zinc, nickel, cobalt, antimony, sulphur, alum, and various other minerals—many rare. The following table shows the quantity and value of this production for the year 1859;—

MINERAL PRODUCE OF AUSTRIA FOR 1859.

Products.	Quantity.	Value.
	lbs.	£
Gold	4,412	222,292
Silver	92,532	308,594
Total Value....	....	£530,886
	Tons.	
Iron (d'affinage) .	282,740	1,716,542
" (demoulage)	39,890	431,521
Total Value....	....	£2,148,063
Coal..........	1,732,000	550,471
Lignite	1,349,200	321,836
Anthracite	840	260
Total Value....	....	£872,567
Copper..........	2,585	266,603
Lead	6,260	159,020
Litharge	1,300	82,119
Lead Ore (exptd.)	1,940	16,465
Mercury	360	73,131
Nickel and Cobalt	386	20,482
Zinc............	1,265	24,157
Zinc Ore	5,390	4,698
Crude Antimony and Regulus .	398	12,647
Antimony Ore ..	92	415
Arsenic	48	570
Sulphur	1,540	15,167
Pyrites..........	7,340	8,996
Sulphate of Iron .	3,220	10,607

Products.	Quantity.	Value.
	Tons.	£
Sulphate of Copper	138	4,988
Alum	1,380	14,014
Aluminous Schirts	36,780	989
Graphite	4,970	6,184
Oxide of Manganese	65	81
Chromium Ore ..	40	189
Tin	51	6,630
	Cwt.	
Bismuth	2	68
	Tons.	
Wolfram	28	281
Uranium Ore	3½	1,650
Orpiment	1½	9
Silver Ore	81	148
Copper Ore......	3,720	7,410
Iron Ore	27,225	17,377
Asphalte Rock ..	330	150
Asphalte	67	882
Total Value....	....	£699,582

SUMMARY.

Noble Metals	12·2 %	530,886
Iron............	52·1 %	2,148,063
Carbonaceous Minerals	19·6 %	872,567
Other Minerals ..	16·1 %	699,582
	100·0	£4,251,098

Comparing the production of the empire during this year with that of 1855, we have the following results:—

Increase—Coal 53°/₀; Lignite 44°/₀; Gold 11°/₀; Iron 15°/₀; Mercury 61°/₀; Zinc 33°/₀; Litharge 215°/₀; Alum 4°/₀; Nickel and Cobalt ores 57°/₀; Zinc ores 36°/₀; Pyrites 96°/₀; and Graphite 36°/₀.

Decrease—Silver 1°/₀; Lead 21°/₀; Nickel-spies 50°/₀; Arsenious Acid 42°/₀; Sulphur 5°/₀; Sulphate of Iron 31°/₀; Sulphate of Copper 36°/₀; and Asphate 58°/₀.

The total number of persons employed in mines throughout the empire, in 1859, was 105,432, comprising 93,270 men, and 12,162 women and children. Of these, nearly 40,000 are employed in Bohemia, Moravia, and Silesia—12,592 being employed in the district of Prague. About 36,000 are employed in Hungary and Transylvania; 7,800 in Styria; 6,000 in Carinthia; 3,500 in Gallicia; 2,900 in Servia and the Banat; 2,300 in Austria (upper and lower); 1,900 in Tyrol; and about 1,000 each in Venetia, Bukowine, and Salzburg.

The number of accidents among this population during the year was 1,187. Of these 838 were slight, 183 serious, and 166 fatal.

ON THE DOUBLE SULPHIDES OF COPPER AND IRON.

By Frederick Field, F.R.S.E.

(From the *Journal of the Chemical Society.*)

About two years ago, I made a verbal communication to the Chemical Society, upon certain double sulphides of copper and iron, produced by the fusion of the native compounds of those metals containing sulphur and oxygen. The experiments which were then enumerated, and which had extended at intervals over several years, have lately been resumed, and now, in a more complete form than heretofore, may perhaps be not deemed wholly uninteresting.

In countries where coal and labour are expensive, and building materials for furnaces, such as fire-bricks, fire-clay, &c., have to be economized as much as possible, it becomes necessary to devise some means in the smelting of copper ores, whereby fuel may be saved, and damage of the furnace alleviated. The process of roasting poor regulus, into a sulphide richer in copper, is that usually resorted to in England, but this roasting acts at the same time, very severely upon the sides of the furnace, as the slag, consisting to a great extent of oxide of iron, combines with the silica of the clay and of the bricks, forming silicate of iron. To avoid this difficulty, advantage is taken of the fact, that oxide and sulphide of copper mutually react upon each other, forming sulphurous acid and metallic copper—

$$2\,CuO + Cu_2S = 4\,Cu + SO_2$$

so that when an excess of the latter is employed, combined at the same time with more or less sulphide of iron, a rich regulus is produced, and the process of roasting is obviated. For example, if into a mass of fused regulus of low percentage, a few hundred weight of the carbonates of copper are introduced, and the whole brought to a state of fusion, the oxide of iron formed combines with the silica of the ore, producing a fusible slag, and a great portion of the sulphur is oxidized at the expense of the oxygen contained in the carbonates. By adopting this method, regulus of a very high percentage may be obtained, and even metallic copper, if sufficient oxygen be present in the mineral to convert the whole of the sulphur into sulphurous acid. Practically speaking, however, this latter plan is seldom or never adopted, the smelter preferring to tap the regulus when it contains from 40 to 50 per cent. of copper, as, if richer, the slags invariably contain much of that metal.

Many analyses have been made of the double sulphides of copper and iron, technically known as regulus, but probably owing to the ores themselves containing many other metals, such as tin, arsenic, antimony, and occasionally silver, it can scarcely be wondered at that the results of the investigations of various chemists upon this particular subject are not very concordant. From my own experience I am led to believe, that copper regulus always has a certain definite composition, and analyses of many specimens, collected from different quarters of the world, fully confirm the idea.

It appears that the copper invariably exists in the state of disulphide (Cu_2S) in regulus, associated with iron in various states of sulphuration. The sulphides of iron seem to exist in certain relative proportions, and the richness or poverty of the regulus in copper, to depend upon the number of the equivalents of disulphide in combination with them. It cannot be denied that certain facts seem to militate against this view, as for example, the action of hydrochloric acid upon the compound. Regulus of from 25 to 50°/₀ copper, generally evolves sulphuretted hydrogen copiously, when treated with this acid, whilst that containing from 60 to 80°/₀ is scarcely acted upon at all; but, nevertheless, the proportions of copper, sulphur, and iron, are so invariable, as to lead us to suppose that it is the great

excess of disulphide of copper, which shields or protects the sulphides of iron from the acid, rather than that those sulphides have changed their chemical condition. And this case is not without a parallel. Silver, so readily oxidized by nitric acid, is not affected by that re-agent when alloyed with an excess of gold; neither, by means of hypodrochloric acid, can zinc be separated from copper, when the latter is in great excess; and, in like manner, when the number of atoms of disulphide of copper, combined with the iron-compound are diminished, much of the iron is dissolved, which, under other circumstances, would remain unaffected. It is, therefore, evident that no results can be deduced as to the state in which the iron exists, by measuring the quantity of sulphuretted hydrogen evolved by the action of hydrochloric or sulphuric acid.

When regulus is repeatedly roasted, and the slag which accumulates upon the surface is skimmed off, a point is arrived at, when all the iron is withdrawn, and a pure disulphide of copper remains, having exactly the same specific gravity, physical appearance, and chemical composition, as the native disulphide, copper glance. The sulphides of iron are all decomposed before the sulphide of copper is attacked, and it would almost appear that this compound plays the part of a base, as regards the sulphides of iron, and that the more concentrated the regulus becomes, the more basic is its composition. If a small quantity of oxide or carbonate of copper be dropped into a fused mass of the sulphide of iron, a disulphide of copper is produced, exercising a certain influence upon the whole compound with regard to the solvent action of acids.

Regulus appears to me to consist of one atom of sesquisulphide of iron Fe_2S_3, one atom of protosulphide FeS, and two atoms of disulphide Fe_2S, associated with disulphide of copper. Thus, a portion of clean regulus from a furnace yielded on analysis—

Copper	36·12
Iron	36·78
Sulphur	27·08
	99·98

or (3 Cu_2S) Fe_2S_3, FeS, 2 Fe_2S. On roasting this compound for some hours, the regulus yielded—

Copper	49·71
Iron	25·34
Sulphur	24·85
	99·90

or (6 Cu_2S) Fe_2S_3, FeS, 2 Fe_2S.

Again, after further roasting and skimming, another sample was subjected to analysis, and the results were as follows:—

Copper	61·34
Iron	15·61
Sulphur	22·90
	99·85

or (12 Cu_2S) Fe_2S_3, FeS, 2 Fe_2S_3.

Although the native yellow copper pyrites have a different composition, the blue sulphides seem to follow the same law, as the artificially prepared regulus. Thus a very pure specimen yielded me—

Copper	54·21
Iron	21·43
Sulphur	24·12
	99·76

or $(8\, Cu_2S)\, Fe_2S_3,\, FeS,\, 2\, Fe_2S,$

which requires—

Copper	. . . .	54·93
Iron	. . . .	21·04
Sulphur	. . . .	24·03
		100·00

It is interesting to observe the rapid decrease in the proportion of iron, in comparison with the sulphur, as the copper augments. When the regulus contains 36°/₀ of the latter metal, it contains also 36°/₀ iron, and about 27°/₀ sulphur. At 50°/₀ of copper, the sulphur and iron are in nearly equal proportions. At 60°/₀ the iron is reduced to 16·5°/₀; and the sulphur to 23°/₀, while at 80°/₀ copper, all the iron has disappeared, and 20 per cent. of sulphur remains.

MR. JUKES' MANUAL OF GEOLOGY.

The Student's Manual of Geology. By J. Beete Jukes, M.A., F.R.S., Local Director of the Geological Survey of Ireland, and Lecturer on Geology to the Museum of Irish Industry. Edinburgh: Adam and Charles Black.

In our last number we referred to Mr. Jukes' labours in the cause of physical and chemical geology, and it is, consequently, an agreeable task to turn to the second and greatly enlarged edition of the work we had then in view.

To our mind, Mr. Jukes' Manual occupies a position distinct from any other complete geological text-book. There are numerous other capital books on the science—profound treatises by great philosophers, and clever compilations by practised book-makers,—but Mr. Jukes gives us the first complete work which can be said to be thoroughly *practical*, such as we should expect from one of the most experienced field-geologists of the day. Indeed, on some portions of geology—such as that division which he classes under the head of Petrology—his book almost stands alone, for we certainly know of none other where these important matters are any thing like so fully treated on.

Next month we shall take the opportunity of referring to some important questions of practical geology, which are raised by Mr. Jukes. At present, we need only say that for mine agents, or any one else desirous of really studying geology practically, we earnestly recommend Mr. Jukes' *Manual.* Mine agents generally, we are sorry to say, have no conception of geology, whatever some of them may think to the contrary. Where they are conscious of their ignorance, which is the case with the abler and more sensible men—who freely admit, like Lord Derby, that they belong to a pre-scientific age—no mischief ensues; but where they fancy they know a great deal, really knowing absolutely nothing; a vast amount of harm is done. We do not value scientific education, as an aid to practical mining and metallurgy, as much as some do; but a close contact with a mining population daily shows us the necessity of an education of the kind, not so much for its practical value, but to save the men from being deluded by the ridiculous speculations of a set of *charlatans.* A work like Mr. Jukes'—sound, clear, and forcibly written,—with matter derived, to a great extent, from field labours, and, consequently, eminently practical, is just the one for the mine agent.

THE MINERAL AGENT'S HANDBOOK.

Mineral Agent's Handbook. By G. C. MAHON, Esq. Edited by the Rev. SAMUEL HAUGHTON, M.A., F.R.S., President of the Geological Society of Dublin; and ROBERT H. SCOTT, M.A., Secretary of the Geological Society of Dublin. London: Williams and Norgate.

THIS book, which is the production of a gentleman who describes himself as a retired conveyancing attorney, is not intended for *mine-agents*, but for a class which the author calls "mineral ageuts,"—that is, agents to landed proprietors, holding a similar position with respect to mineral properties that land agents hold with respect to agricultural property,—and it is exclusively confined to the consideration of metalliferous mining. In the English metalliferous mining districts there is no such class as Mr. Mahon contemplates, the mineral property being managed by the ordinary steward associated with a practical mine-agent; and we doubt if, in any country, there is scope for such a profession as that of an agent devoting himself exclusively to the mineral exploration of estates in the interest of the landlords.

In fact, this Handbook may be considered as an *amateur* guide to *amateur* mining. It is not a work for practical men; but for land-owners and land-agents it will be found extremely useful, for it contains a vast amount of valuable information, ranging as it does from mineralogy to dialling, and from mine-exploring to conveyancing. We think, however, even on the latter subject, some of Mr. Mahon's views would be modified by a couple of years' practice in Cornwall.

THE *ANNALES DES MINES* ON THE PRESENT POSITION OF THE METALLURGY OF IRON IN ENGLAND.

Annales des Mines, ou Recueil de Mémoires sur l'Exploitation des Mines, et sur les Sciences et les Arts qui s'y rapportent. Rédigées par les Ingéneurs des Mines, et publiées sous l'Autorisation du Ministre des Travaux Publics. Cinquième Serie. Tome XX. 1861. Paris: Dunod, Quai des Augustins.

WE regret, in consequence of the pressing engagements of the gentleman who was making the abstract of these papers for us, that we have not yet been able to complete them. This, however, is of the less consequence, as the papers themselves are not yet completed in the *Annales des Mines.* We shall continue our abstract next month.

MANCHESTER GEOLOGICAL SOCIETY.

February 25*th*, 1862.—Joseph Dickinson, Esq., F.G.S., President, in the Chair. After the conversation on the Miners' Permanent Relief Fund, the following paper was read: "On Mr. Aytoun's Patent Safety-Cage for Mines." By Mr. J. J. Landale, Mining Engineer, Edinburgh. Read by Mr. Binney.

The description given in this paper, was illustrated by large coloured drawings; and, as it would not be understood without graphic illustrations, it will be necessary to rest satisfied by saying that the principle of Mr. Aytoun's Safety-Cage appears to differ from that employed in those in ordinary use, in this, viz.—that it provides for the safety-apparatus being quickly brought into action, by the intervention of two strong springs, before the cage shall have acquired a dangerous velocity; whereas those in previous use, have no provision for hastening the action of the safety-apparatus, except the weight of the cage and its contents. The author of the paper

seemed to consider that all the safety-cages previously brought before the public had been complete failures; but he thinks the fate of the one he described different, as the principle upon which it is constructed, will render the miner in his descent to, and his ascent from, his daily labour, nearer *complete safety* than he has hitherto been.

The President—It is perhaps going too far to say that all these safety-cages, which have already been tried, have proved failures. We have Owen's Safety-Apparatus in this county, which is working well, and it appears to me to be giving great satisfaction. I think the remarks of Mr. Landale, in this respect, must be taken as applying to those they have had in Scotland, not to those in this part of the country.

The first part of the paper by Mr. J. J. Atkinson, Her Majesty's Inspector of Mines for the South Durham District, "On the Gases met with in Coal Mines, and the general Principles of Ventilation," was also read. This paper, which was continued and concluded at the meeting of March 25, is one of the most able and exhaustive elementary treatises ever yet given on the subject of ventilation, treated in a small compass. It does infinite credit to the author, and equal honour to the Society at which it was read. It would be impossible to give any adequate notion of it in a short abstract; and it is the less necessary to attempt to do so, as it is stated that it will appear in a separate form. It can be had at the present moment, by procuring Nos. 11, and 12 of the Transactions of the Manchester Geological Society, which are published, at Sixpence each, by Messrs. Thomson and Baxter, 40, Princes Street, Manchester.

GEOLOGICAL SOCIETY OF LONDON.

March 19*th*, 1862.—Professor A. C. Ramsay, president, in the chair. Elliot Square, Esq., London; Ernest Shelley, Esq., Avington House, Winchester; Edward Romilly, Esq., 14, Stratton-street, Piccadilly; the Right Honourable Edward Cardwell, Esq., M.P., 74, Eaton-square; George W. Stevenson, Esq., F.S.A., C.E., Halifax; George W. Hemans, Esq., C.E., 32, Leinster Gardens, Bayswater; and Harvey B. Holl, M.D., Malvern, were elected fellows.

The following communications were read:—

1. "On the Sandstones, and their associated Deposits, in the Valley of the Eden, the Cumberland Plain, and the South-east of Dumfriesshire." By Professor R. Harkness, F.R.S., F.G.S.

2. "On the Date of the Last Elevation of the Central Valley of Scotland." By Archibald Geikie, F.R.S.E., F.G.S. After alluding to the position and nature of the raised beach, which, at the height of from twenty to thirty feet above the present high-water mark, fringes the coast-line of Scotland, the author proceeded to describe the works of art which had been found in it. From their occurrence in beds of elevated silt and sand, containing layers of marine shells, it was evident that the change of level had been effected since the commencement of the human period. The character of the remains likewise proved that the elevation could not be assigned to so ancient a time as the Stone Period of the archæologist. The canoes which had from time to time been exhumed from the upraised deposits of the Clyde at Glasgow, clearly showed that at the time when at least the more finished of them were in use, the natives of this part of Scotland were acquainted with the use of bronze, if not of iron. The remains found in the corresponding beds of the Forth estuary likewise indicated that there had been an upheaval long after the earlier races had settled in the country, and that the movement was subsequent to the employment of iron. From the Firth of Tay similar evidence was adduced to indicate an upheaval possibly as recent as the Roman occupation. The author then cited several antiquaries who, from a consideration of the present position of the Roman remains in

Scotland, had inferred a considerable change in the aspect of the coast-line since the earlier centuries of the Christian era. He pointed out also several circumstances in relation to these Roman relics, which tended to show a change of level, and he referred to the discovery of Roman pottery in a point of the raised beach at Leith. The conclusion to which the evidence led him was, that since the first century of our era the central parts of Scotland, from the Clyde to the Forth and the Tay, had risen to a height of from twenty to twenty-five feet above their present level.

MINERS' PERMANENT RELIEF FUND.

A MEETING of delegates representing the miners of Northumberland and Durham was held in St. James's Chapel School-room, Newcastle, on March 29, to hear the report of the deputation appointed to wait upon the Committee of the Coal Trade, in order to ascertain their sentiments respecting the establishment of a permanent relief fund, and to transact other important business relating to the proposed fund.

The Chairman (Mr. John Howie) read the report of the interview of the deputation with the Committee of the Coal Trade on the 18th March. It stated—Upon being admitted the resolutions of our committee were read, after which we were requested to state their views. We referred to our resolutions, by which we had agreed to subscribe one penny per week per man, and boys under eighteen one halfpenny, for the relief of distress caused by fatal accidents and permanent disablement. We hoped the masters would pay an equal amount. The management of the fund, we considered, should be equally divided between masters and men, and were wishful that a third party should have a voice in the management, such as the National Association, or honorary members who might be wishful to assist the miners in carrying out a permanent fund by becoming subscribers. The masters, however, did not see any necessity for a third party, considering that the masters and men were competent to manage their own business. We said we thought the men believed that a third party of disinterested subscribers would assist very materially in carrying on the business to the satisfaction of all concerned. We were asked if we had made any calculations as to how far our subscription of one penny would meet accidents? We said we believed the amount mentioned, if equalled by the masters, would go far to meet fatal accidents and permanent disablement, but we believed that if it should prove to be insufficient the men would willingly pay a little more. Some discussion then took place on the propriety of it being a national fund, or whether it should be confined to these two counties. The masters appeared to be much opposed to going beyond these two counties. They thought that the management would be much more simple if the business of each large district, such as these two counties, was confined to itself. If it were proposed to admit any single parties belonging to other districts to a participation in the benefits, the result would be great confusion, and perhaps discord in the distribution of the funds. In fact, they considered that the proper management of the fund, if national, almost, if not altogether, impracticable, and any attempt to carry it out to such an extent might interfere very much with its usefulness.

After a lengthened discussion of details, before leaving, we wished to state that we considered that the masters were entitled to pay as much as the men, not as a matter of charity, but in justice. We thought it would be admitted, that a great number of accidents happened through the want of proper care and attention on the part of the employers, or those having charge under them, and in justice the masters ought to relieve distress caused by such neglect. On the other hand, we were willing to admit, that many accidents happened for which the men were blameable them-

selves, and on the same principle of justice we had a right to meet them; but, after all, a great number of accidents happened which could not be foreseen, and for which nobody was blameable. Who is to pay for them? Let the masters and men meet such cases between them, and then all would be provided for. The masters did not wish to discuss the subject at present. They wished another delegate meeting to be called, as they expressed doubts as to whether a majority of the men wished the fund to be national or not, and they likewise wished to know the result of a full meeting on the permanent disablement clause. We therefore agreed to call this meeting.

It was then resolved:—"That each man subscribe one penny a week, and each boy under eighteen a halfpenny, to the permanent fund for the relief of the distress arising from fatal accidents and permanent disablement, and that an equal amount should be solicited from the masters, such subscriptions to be applied to the relief of the distress caused by any fatal accidents as might happen to any paying member during the time which may elapse before such fund is permanently established."

Within the last few days, the *Newcastle Daily Chronicle* states that the Secretary to the above fund has received a letter from the Secretary of the Coal Trade, to the effect that the committee of that trade has held a special meeting upon the proposed fund; that they have considered it in all its bearings; and that they are now ready to give their decision to the deputation which was appointed at the last delegate meeting. The day fixed is Tuesday, the 29th April, for the interview. Then the committee will probably call a general delegate meeting, to be held on Saturday, May 10th, at Newcastle. The committee hope that each colliery will send delegates to such meeting, to hear the decision of the coal trade, to adopt some practical resolution towards the establishment of a Miners' Permanent Relief Fund.

The following discussion, which took place on this subject at the meeting of the Geological Society of Manchester on February 25th, will probably be read with interest:—

Mr. E. W. Binney asked the opinion of the meeting upon the propriety of forming a local fund for the relief of widows and orphans and other persons dependent upon men killed, or disabled in following their occupations as coal miners. He said, if a district association were formed in Lancashire and Cheshire instead of a central association in London, as was proposed, it would probably commend itself more to the coal owners and the public here than the one in London, and the funds would probably be better dealt with, and the colliers would have more faith in it. Probably the best way to proceed would be to call a public meeting of the coal proprietors, and Manchester was a place where such a thing might be started.

The President said, he understood that there was already a surplus from the Hartley Colliery Fund, which was to be applied as the nucleus of a fund for the Northumberland and Durham miners, who had expressed their preference for a local fund rather than a national one. There was ample scope for a local fund for Lancashire and Cheshire, and the Manchester Geological Society was a very proper medium by which to bring it before the public, because it stood on neutral ground.

Mr. Andrew Knowles thought that if the fund were confined to Lancashire and Cheshire the money would be more equitably distributed than by a London association. Mr. Binney had not explained the manner in which the fund, when collected, should be distributed.

The President said the fund would, no doubt, be for the widows and others dependent on those who might loose their lives.

Mr. Binney said, the manner of distribution would be a proper subject for discussion at a meeting to be called to consider how the subscriptions could be raised. No doubt, the coal proprietors and the colliers themselves would contribute, and it was a question whether a sick-club might not be connected with the fund; but all those are things to be decided hereafter.

The President—Sick clubs seem to be already well managed by the people who have started them.

Mr. John Fletcher—Are you not magnifying the necessity for a call of this kind upon the public? I think I am right in saying that whenever an accident has happened there have been sufficient funds provided in the neighbourhood. The recent Hartley case, of course, has become a national affair; but I do not think we should infer from it that it has become necessary that the whole nation should be called upon to meet accidents of this kind. I think there is a disposition on the part of colliery owners to assist liberally; and as long as the accidents are diffused over the country, they are met in the ordinary way.

The President—It is generally found that in small accidents, where only one or two persons are killed, the relations are not provided for so well as in more extensive cases.

Mr. Fletcher—Of course, they are not provided for so well as the relatives in the case of the Hartley Colliery. It has been suggested as desirable to form a fund, to be provided by the workmen and masters. I am not at liberty to say all I know on the subject, but it is a matter that is being now mooted, and may probably be the subject of legislative enactment.

The President suggested the propriety of adopting some resolution upon the subject.

Mr. Lacey agreed that the most natural way of forming a fund, seemed to be by weekly contributions generally, both by men and masters, over the whole district.

Mr. Fletcher suggested that the subject might be adjourned till after the proposed discussion by the mining association in London.

Mr. Binney—The only question is whether a fund of this sort would not be better managed on the spot—whether the men would not have greater faith and confidence in it. If the money which they contributed was sent to London, and London men were to come down and investigate every case, it would seem a round-about sort of way of doing it.

Mr. Fletcher—The distribution of the money is an important question; the first thing, however, is how to raise it.

Mr. Binney—It has been proposed to charge ½*d.* or 1*d.* per ton upon the coal.

The President—The question is a very proper one for discussion; but a special meeting should be called to discuss it.

Mr. Atkinson (honorary secretary)—A charge of ½*d.* per ton upon the sixty millions of tons raised annually, would amount to 125,000*l.* a-year, and that would be a very large fund. Would it not be desirable to call a public meeting of miners and geologists on the subject? I will propose, "That a meeting be held at some convenient and not distant day, for the discussion and investigation of this subject."

Mr. Fletcher—Seeing that this matter is to be brought forward in London before our next meeting, I think it would be better to leave it over until then.

The President—Then I will take that as the pleasure of the meeting.

Correspondence.

[We need scarcely say that we cannot hold ourselves responsible for the facts or opinions of our correspondents; although we shall make it a point to endeavour to exclude those who are obviously inaccurate or fallacious, as far as is consistent with our wish to encourage the freest discussion.]

PRACTICAL MINING.

Sir,—Considering that one of the great items of expenditure in working our metallic mines is the cost of sinking shafts and driving levels, it is a question of some importance to us miners to consider,—Whether, or not, we are conducting this part of our operations in the most economical way possible? As the subject is an eminently practical one, a few remarks thereon may, probably, not be out of place in your magazine.

Our forefathers, the early miners of this country, conducted their explorations on a much smaller scale, or system, than we do now; their levels being generally carried only from 5 to 6 feet high and from 2 to 3 feet wide, and their shafts small in proportion; but in all well-conducted mines now at work, the shafts and levels are very much enlarged upon the above-named dimensions, greatly to the benefit of the mines, both in point of economy in the cost of driving or sinking, as well as to the securing an improved ventilation. But it may be doubted whether we are, even now, carrying our shafts and levels to their full and proper size to secure the advantages above-named. There appears to be too great a tendency among mine agents to direct the mines to carry levels only at a given height and breadth, irrespective of the character of the ground to be explored. A certain height and breadth, in which the men can move freely and transport their ores to shaft without inconvenience, may do very well in soft ground, but in hard blasting ground, where from 50 to 150 holes are bored and blasted to excavate a fathom in length, it may be doubtful whether it is wise to confine a level to 7 feet, or even to 8 feet high, and a proportionate breadth. The character of the ground should rather regulate the dimensions of the exploration. It will readily be admitted that, in all hard ground such as referred to above, the labour and materials expended in excavating a fathom of ground, is greatly in excess of, or out of proportion to, the bulk of rock removed, supposing the powder for the blast could always be deposited at the most advantageous point for it. And it must also be allowed that there is a great deal of abortive labour bestowed by even the most experienced miners, and that not from any carelessness or want of judgment on their part, but purely from circumstantial difficulties,—the peculiar nature and structure of the rock operated on. Thus a "kindly hole" often fails to "tear its burden;" and in the opinion of the writer the only effectual remedy that can be applied, is an enlarged space or excavation.

To illustrate this proposition, it is only necessary to refer to the modern mode of quarrying, by which it has been proved that by extending the scale of operations, powder and labour have been economised immensely. Of course the conditions under which the rock is blasted in a quarry and in a mine, are not properly the same; but the principle holds good in the one case as in the other, and to explain this principle it should be observed that the mode of operation is constant in all cases—that is, the effect of the combustion of powder in a given body of rock is as purely mechanical as that of splitting a rock by a wedge; for, although there may not be an appreciable point of time between the commencement and end of the combustion, yet in no case is the combustion absolutely instantaneous.

There is an interval, during which the accumulating force exerts itself, until the resistance is overcome, and the explosion takes place. If then the *modus operandi* of splitting a rock by powder is substantially the same as by the wedge, it follows that the conditions required to secure the full efficiency of the powder must be the same as those required in the use of the wedge; and with this view of it, it will be seen that in all hard and difficult rock a large space is requisite to open to the charge the line of least resistance. The character of the rock should therefore determine the size of the excavation. A regular lode, though very hard to bore, may split very well between two well defined walls, or even with one; but in cases of difficulty, as are often occurring in most large mines, when, to use a mining phrase, "there is no head nor bed," or when the natural clearage or structural joints run adversely, then the difficulty is largely increased in a small excavation. To make this as clear as possible, it should be remarked that all rocks are more or less crystalline, and, consequently, have their lines of clearage, termed by miners and quarrymen, "the grain of the ground." This grain is along the line of the greatest number of the facets of the crystals: these facets, of course, differing in their size, direction, and the perfection of their development; some being very minute, in the so-called compact rock, they are even microscopic; but the crystalline structure exists in every rock, and the line of least resistance which the rock offers, independent of walls and structural joints, is along the line of the greatest number of the facets.

Now, to find these, and plan the holes so as to follow them successfully, is, in some rocks a very difficult matter, even to the most experienced of miners, and in a small level is almost impracticable: hence we have so many holes bored and blasted to no purpose. A standing proverb, in olden time, among miners was "Pool adit," and many modern miners have had their own difficult bars of ground to excavate as well; but there is reason to believe that these even would be penetrated much more readily if the level were carried large enough to admit the miner boring his hole at the proper angle of inclination so as to deposit the powder in accordance with the "grain" or crystalline structure of the rock, and to give extended space for the explosion; and this will apply to rocks of extraordinary hardness, and equally to blasting-ground in general.

If the above views are correct, it is evident that it is not easy to define limits for our explorations, the enlightened judgment of all parties interested must be the only guide in the matter, but it does seem that enlarged space is required in most, if not in all hard ground bargains.

The want of good facilities for removing the refuse broken, is, perhaps, an impediment in some mines, but this objection cannot remain in force in the mining world long, as improved modes of winding are being generally introduced.

To convince the miners of the truth of the foregoing remarks, may be a work of some difficulty. To alter any system established and confirmed by the practice of ages, will, in any case, require energy and perseverance; but, in metallic mines it may be expected to be especially the case, scattered, as they are, over the world, with a widely divided management and a changing population.

Probably, to convince the Cornish agents as well as the miners, that a level twice as large, might in some cases, be driven cheaper than an ordinary one, may be no easy task, but a temperate and persistent agitation of the matter by those whose province it is to influence opinion, may accomplish much.

Another and weighty reason why enlarged excavations should be made, is the improved ventilation of the mines which would result therefrom.

In the early days of our mining experience, when levels were carried much smaller than they are now, the air to work had to be forced into them by air machines; but enlarged levels, and a system of sinking winzes more

frequently, have removed these air-machines almost entirely; still, it must be admitted, that in very many mines—even in those best managed—there is room for improvement, and by enlarged levels this may undoubtedly be secured.

Pneumatics, as a science in relation to our metallic mines, is but imperfectly practised or understood. How to send a constant supply of fresh air to the end of the longest level upon natural laws, is a subject not so much studied by mine agents as it should be. Experience, however, teaches that in a small level the air and powder smoke lie stagnant, while in a large level a constant motion is obtained and kept up. In levels varying from 6 to 8 feet high, with proportionate breadths, the difference in ventilation is immense; in the larger level a current of fresh air will circulate inwards at the bottom of the level, and the impure air and noxious gases, of course, move outwards at the top of it; but in a 6 feet level the circulation is comparatively little.

I am, Sir, your obedient servant,
W. VIVIAN.

Pary's Mines,
April 17th, 1862.

OBSERVATIONS ON SILICA.

SIR,—In the "Observations on Silica," by Mr. Church, contained in the Magazine for April, I have noticed his remarks on the tendency of silica to deposit in a globular form, and would respectfully suggest that this form of silica, as seen in agate, chalcedony, and other stones, is purely the result of crystallisation—the system of crystallisation being the radiate—and is seen under a good microscope, either in opaque polished surfaces, or in thin sections, with transmitted polarised light. The mode of action being—that in passing from the fluid to the solid state, or condition, every atom of the silica arranges itself in radiating lines from the centre of the group outwards, and I am inclined to think, that the concentric rings, and so-called fortification lines, are the result of a modification of the atomic arrangement, rather than a change of substance in the deposition.

The globular form of deposition is not peculiar to silica: it is also seen in many other minerals—in stalactitic lime, in carbonate of copper (malachite), and in fact, in numberless combinations; but, from considerable observations on the subject, I have formed the opinion, that the globular, mamillary, botryoidal, and other kindred forms, are all the result of the central radiate system of crystallisation alone. Of course, they are modified according to circumstances; for instance, in a mass of matter, on the point of changing from the fluid to the solid, crystallisation may commence at several centres at the same moment, and the radiate crystals may advance outwards and press into the domains of their neighbouring centres, modifying their external forms considerably. This effect is beautifully seen in some malachites and agates, and a fine illustration of the process is witnessed in the crystallisation of some of the chemical salts under the microscope by the aid of polarised light.

Yours obediently,
W. VIVIAN.

Pary's Mines, near Bangor,
April 16th, 1862.

SIR,—In your magazine, No 4, page 241, the writer on "Faults, Dislocations, and Disturbances in Coal Mines," seems to confound the Ninety-fathom dyke with the Cock-field-fell dyke. I beg to observe that they are separate and distinct dykes. That designated the Ninety-fathom, is situated in Northumberland, while the Cock-field-fell dyke is in Durham.

I am, dear Sir,
Your obedient servant,
JOHN CURRY.

Boltsburn, Eastgate,
April 22nd, 1862.

Legal Notes.

On the 22nd March, the cross actions of *Island of Anglesey Coal and Coke Company v. Laurie*, and *Laurie v. Island of Anglesey Coal and Coke Company (Limited)*, came on for hearing at the Assizes at Beaumaris, before Mr. Justice Keating. The circumstances were these: early in 1860, the Company, being desirous of more capital, entered into negotiations with Mr. Laurie for the purchase by him of a moiety of their interest in their lease of the coal mine. An agreement was ultimately made, by which Mr. Laurie was to become the purchaser of one moiety for £5,000, to be advanced by sums of £1,000 every half-year. The Company's action was to recover the third instalment, which Mr. Laurie refused to pay. Mr. Laurie's action against the Company was for misrepresentation as to the value of the mine and the extent of their liabilities. The records in both actions were withdrawn, upon terms agreed upon.

On the 21st and 22nd March, the cause of *Hill and another v. Taylor and another*, was tried at the Derbyshire Assizes before Chief-Justice Cockburn and a special jury. The plaintiffs represented the Great Hucklow and the defendants the Mill Dam Lead Mining Companies. The litigation had already continued for upwards of a year and a-half in the Court of Chancery, and had now reached great proportions, the witnesses on both sides being upwards of fifty. The question to be decided was really a very simple one, namely, whether the defendants had the right to turn the water from their mine into a "swallow" existing in the Beech Grove Mine, belonging to the Great Hucklow Company. The latter contended that the "swallow" being in their ground, they had the exclusive right to use it; while the Mill Dam Company maintained that, as an ancient watercourse, they had a right to turn their water into it instead of pumping it to the surface. The evidence involved numerous questions of fact, and also as to the mining customs of North Derbyshire. Among the plaintiffs' witnesses, was Mr. Petherick, the eminent mining engineer, who had been commissioned by the Vice-Chancellor to make an examination of the mines. Mr. Petherick, proved that the water from the defendants' mines could not get to the "swallow" without going through what was indisputably the plaintiffs' ground; that the defendants had cleared out, but not otherwise altered, the "old man's drift;" and that, although the "swallow" was capable, under ordinary circumstances of easily carrying off the water from all the mines; yet that, under certain circumstances, it would have the effect of stopping the plaintiffs' mines.—After a considerable amount of evidence had been gone through, the Chief-Justice said: "I have a very strong opinion upon the case, which I think I ought to express before it goes further. I think I never heard or had to deal with a case of a more litigious nature than this. According to Mr. Petherick's opinion, it is quite clear, that some arrangements might be made by which, except upon extraordinary occasions, the whole series of mines might be drained through this "swallow." This day's proceedings cannot terminate the dispute between the parties, and what I want to suggest is, is it not possible to have this question settled without going through the long litigation which must follow if the case is not referred? I never felt so strongly upon a case, and I think some arrangement might be made by which some competent person shall be called in to decide upon what shall be done." After some consideration and delay, it was ultimately agreed to refer the whole merits of the case to Mr. Petherick, who should have power to call in a legal assessor, and take such means as he should deem proper to settle all questions between the parties, and decide the conditions upon which the "swallow" should be used.—The cross action of *Hewitt and another v. Hall*

and others, involving the same facts, was also agreed to be referred on the same terms.

On the 11th and 12th April, the arbitration in the important mining case of *Cottam v. Williams*, came on at the Hen and Chickens Hotel, Birmingham. At the last Stafford Assizes this case was set down for hearing, the plaintiff seeking to recover £1,600 for damage done to the Vulcan Iron Works, Greet's Green, by reason of the defendant's mining operations. The land upon which these works were built was originally sold by defendant, who, in the deed of conveyance, reserved to himself the right to the mines and minerals underlying the surface, and also made a provision that he should not be responsible for any results to the surface arising from the proper working of the mines. Soon after the opening of the case, Mr. Justice Crompton suggested that as some points of law would naturally arise for consideration by a higher court—and especially the point what was meant by a "proper working,"—an arrangement should be come to, by which the question should be referred to arbitration. The suggestion was acceded to, and Mr. Mathews (barrister) was named, and agreed to, as arbitrator, and this gentleman sat on the days named. The whole of the two days were occupied in hearing the evidence of the plaintiff and his witnesses; when it was agreed that an adjournment of three weeks should take place, in order to allow time for a compromise being arrived at.

The very peculiar case of Mr. Samuel Griffiths seems to have created considerable interest at Wolverhampton. This gentleman had been arrested on a *capias*, issued by the county court judge of the district under the provisions of the Absconding Debtors' Arrest Act, at the instance of Messrs. Hughes, on the allegation that he was about to leave the country. This allegation Mr. Griffiths denied; and he also contended that he did not owe Messrs. Hughes any sum of money now payable, inasmuch as he had obtained his protection under the arrangement clauses of the Bankruptcy Act, his deed of arrangement having been signed by 164 creditors out of 196, and thus made obligatory on the minority who did not sign. Considerable personal feeling seems to have been imported into the matter, and the statements and arguments before the county court judge were of a very lively description. Ultimately, Mr. Griffiths, being unable to submit to the delay, put in bail.

The next Sittings of the Stannaries Court will be held at Truro on the 14th May.

On the 24th April, a motion was made before Vice-Chancellor Sir W. P. Wood, on behalf of certain shareholders in the South Lady Bertha Mining Company, for an injunction to restrain proceedings at law, which had been commenced against them by persons claiming to be creditors, to recover sums alleged to be due for work and labour supplied to the company. It appeared that a petition had been presented to have the company wound up; that would probably be heard in a few days. In support of the application it was contended that, after the presentation of the petition for winding-up, there was inherent jurisdiction in the Court to protect individual shareholders from being harassed by creditors of the company, and that section 84 of the Winding-up Act of 1856 pointed to the same result. The Vice-Chancellor said that he had no jurisdiction to restrain these proceedings by creditors. It was true that the mere presentation of a petition for winding-up a company had the effect of staying all proceedings in the Stannaries Court; but that was applicable to the Stannaries Court only, and the Winding-up Acts expressly provided that a petition, or even an order for winding-up, should not have that effect. The motion must therefore be refused, and the *ex-parte* injunction that had been obtained must be dissolved, with costs.

In the case of *Oxlade v. the North-Eastern Railway Company*, Mr. Oxlade made an application in person to the Court of Common Pleas for a rule calling upon the North-Eastern Railway Company to show cause why an

injunction should not issue, commanding them to deal with Mr. Oxlade, and to carry coal for him in like manner to and from the same places and upon the same terms as they carry for any other person. Mr. Oxlade read a very long affidavit in support of his case, the principal points of which were that he had brought an action against the company for refusing to carry coal for him upon any part of their railway, and in particular from Whitwell, Shincliffe, and Ferry Hill stations. The action was tried at York Summer Assizes, 1860, when a verdict was given for the plaintiff with damages, and the special jury also found that the company were common carriers. This verdict was afterwards set aside by the Court of Common Pleas, from whose decision Mr. Oxlade appealed to the Court of Exchequer, who ordered a new trial to take place. After considerable discussion, Lord Chief-Justice Erle said: I think this rule must be refused. The Court of Exchequer Chamber have ordered a new trial, and I think this Court ought not to grant an injunction to command the company to carry until the facts are more fully proved between you. That can be done by the new trial.—Mr. Justice Willes: I am of the same opinion.—Rule refused.

At the Birmingham Police Court, on April 22, the charge of E. B. Thorneycroft and Company against Mr. Izod and others again came on for hearing before Mr. Kynnersley, stipendiary magistrate. The complainants were Mr. Edward Bagnall Thorneycroft and another (Mr. S. Griffiths), trading under the name of E. B. Thorneycroft and Company, and the defendants were Mr. William Izod, iron merchant, Stafford-street, Birmingham; Mr. Frederick Hill, clerk to Mr. Izod; Jacob Poole, Wolverhampton, clerk to Mr. S. Griffiths; James Sutton, Wolverhampton, also clerk to Mr. S. Griffiths; and Thomas Leighton, a boatman, living at West Bromwich. The case, which is a most peculiar and complicated one, was before the Court for two days, and was again adjourned. A cross-charge has been made by Mr. Izod against Mr. Griffiths and one of his clerks. These cases—and indeed Mr. Griffiths' matters generally—create great interest in the district.

Notes and Queries.

The *Annales des Mines* has now entered upon a 6th series: the 5th series closed with the 20th volume.

The following is the production per head, of coal and iron, in each of the principal European counties of the United States :—

Coal.	lbs.	Iron.	lbs.
1. Great Britain	5,550	1. Great Britain	285
2. Belgium	3,950	2. Belgium	140
3. Prussia	1,705	3. United States	60
4. Saxony	1,570	4. France	52
5. United States	1,055	5. Prussia	50
6. France	450	6. Bavaria	21
7. Austria	200	7. Austria	21
8. Bavaria	120	8. Russia	8
9. Russia	2		

Provisional protection has been granted to Mr. John Napier, of Glasgow, for "Improvements in Apparatus for Cooling the Water employed for Condensing Steam or other purposes." The water, after being discharged from the condenser, is caused to flow into a trough placed on the top. In the bottom of this trough a number of vertical tubes are placed, extending some way upwards and downwards, open at the top, and made of any porous material (or non-porous material, if they have small perforations all over them) through which the water can ooze or percolate. Through these

a current of cold air is forced, which cools the water by coming in contact with it as it percolates through them.

Letters patent have been granted to Mr. John Watson, of Glasgow, for "Improvements in Furnaces," for heating boilers and other similar purposes.

Letters patent have been granted to Messrs. Edmund Suckow and Edward Habel, of Oldham, for "Improvements in Producing a Strong Blast or Current of Air." The inventors enclose an archimedian screw in a cylinder, and give it a rapid rotary motion, by which a strong blast or current of air is produced similar to an ordinary fan, but with a more powerful effect.

A miner's delegate meeting from the various collieries in Northumberland and Durham was held at Newcastle, on the 22nd March, and was well attended. It was reported that the miner's petition had been well signed. Statements were made by various delegates respecting the condition of the collieries in their respective districts—as to the number of shafts, and their condition—ventilating appliances, &c., affording information of considerable interest. The tone of the meeting appears to have been fair and moderate; but their success among the population of the different colliery districts seem to have been varied: one delegate reported the men at Rainton to be "as dead as a hammer with respect to their interests."

The Directors of the General Mining Company for Ireland, have apprised all zinc smelters (by advertisement) that they are now in a position to furnish in quantity regular supplies of calamine, containing a high percentage of metal. They state that the quality of the spelter made from this ore is of the first class, and very superior to that manufactured from blende.

Mining, Quarrying, and Metallurgical Intelligence.

CORNWALL AND DEVON.

The Royal Commissioners appointed to inquire into the condition of the metalliferous mines in the kingdom, with reference to the health and safety of the persons employed therein, have commenced their labours in Cornwall. The commissioners, consisting of Lord Kinnaird (chairman), Hon. F. Egerton, Mr. N. Kendall, Mr. H. A. Bruce, Mr. J. St. Aubyn, Mr. R. Davey, Mr. Headlam, Mr. P. H. Holland, and Dr. Greenhow, with Mr. Robert Temple, the secretary, have been staying at Liskeard, where they have examined witnesses from the neighbourhood of St. Austell and Par.

Miners' Association of Cornwall and Devon.—The Quarterly Meeting of the Miners' Association of Cornwall and Devon was held at Camborne, on the 9th April—Mr. J. F. Basset of Tehidy in the chair. The chairman announced that the President, Mr. Charles Fox, was prevented from being present, but he had written a letter, which would be read by the secretary. The following Papers were read:—

"On Winding," by Mr. J. Hocking, jun.

"On the Relative Merits of Skips and Man-engines for Raising and Lowering the Labourers in Mines," by Captain Josiah Thomas, of Dolcoath.

"On the Formation of Mineral Veins," by Mr. Reginald Grylls.

WALES AND THE BORDERS.

South Wales Institute of Civil Engineers.—The quarterly general meeting of the members of this Institute, was held at the Town Hall, Cardiff, on the 16th April—Mr. William Adams of Ebbw Vale (President), in the chair. The President stated that the officers who went out of office

during the ensuing year, were himself, as President, Mr. Menelaus, and Mr. T. Evans, as Vice-Presidents, and the members of the Council—most of whom were eligible for re-election. The Council were unanimous in recommending Mr. Thomas Evans, Government-Inspector of Coal Mines for the district, as President for the ensuing year; Mr. Menelaus and Mr. Adams (the retiring President) were also proposed as Vice-Presidents; Messrs. Basset, Martin, Greenwell, Levic, Rhys, Roberts, Cox, and Kirkhouse, as members of the Council; and Messrs. Williams and Brigden, as Secretary and Treasurer respectively. The following gentlemen were elected members:—Messrs. Frederick Davies, Aberdare; W. Child, Dowlais; J. E. Williams, Newport; W. H. Thomas, Swansea; and W. T. Lewis, Aberdare. The following papers were read:—

"On the Motions of Valves in Steam-engines," by Mr. Cope Pearce of Cyfartha, and "On Professor Jenner's Diagram, for showing the motion of the Slide Valve," by Mr. R. Schmidt. These papers being of an intricate nature, were ordered to be printed, the discussion being postponed to the next meeting.

The Paper by Mr. Mark Fryar, F.G.S., "On the Sanitary Condition of Mines," read at the last quarterly meeting (see M. and S. M., vol. 1., p. 51) was submitted to discussion. Mr. R. Bedlington, Mr. A. Bassett, Mr. Nasmith, Mr. Cox, and the President, took the principal part in the discussion, which went to show that, as far as South Wales was concerned, some of Mr. Fryar's remarks scarcely applied.

"On a plan to improve Canal Locks, and render Canal Carriage less costly," by Mr. G. Ashcroft. No discussion took place on this paper.

"On Giffard's Injector," by Mr. T. Dyne Steele, C.E. A discussion followed in which the author, Mr. Tomlinson (Superintendent of the locomotive department of the Taff Vale Railway), Mr. E. Williams, and the President took part. All admitted the practical success of the injector, but none seemed able to explain theoretically its action.

"On the Selection and Treatment of Coal for the Blast-furnace and Cupola," by Mr. Cox. The discussion was adjourned until the next meeting.

Trade Report.—The Continental States still receive extensive supplies of iron from this district; the principal iron works in the neighbourhood of Aberdare, Merthyr, &c., have some good orders on their books, and the works are therefore actively employed. From the remarks which were made by some of the principal iron makers at the South Wales Institute, held last week, the trade has improved within the past two or three months, whilst there is every prospect of still further progression. Mr. Peters, in a good practical after-dinner speech, remarked that everybody must have been surprised at the large quantities of iron which had lately been exported to France, and when they considered that, comparatively speaking, but few things were made of iron in that country which should be, he considered that the recent free-trade measures would have a most beneficial effect, and that very large quantities of iron would be exported to that country for the general purposes of trade. The President (Mr. Adams, of Ebbw Vale), and other gentlemen present, held out cheering prospects for the South Wales iron trade, consequent upon the demand which must soon spring up for iron-plates to meet the requirements of the navy. South Wales was in a position to produce plates of any size and description, and in any quantities required, and it was believed that no other part of the country would be able to produce better or more enduring plates. The coal trade is not so brisk as it was some few weeks since, consequent upon a temporary depression in the shipping trade in the several ports, but there is a good demand in Newport for coals for the coasting trade. Since the opening of the South Docks, at Swansea, the coal trade has received a considerable impetus, which will be proved by the returns which have just been made of the quantities of coal shipped there

during the first quarter of the present year. The returns are as follow:—For January, 22,407 tons; for February, 21,056 tons; and for March, 24,226 tons; being a total of 67,689 tons for three months, or at a rate of upwards of 270,000 tons per annum. These shipments are exclusively in the South Docks, which would be lost to the port had not the docks been opened, for the trade in the North Docks is quite sufficient to keep the whole of the coal drops fully occupied. The foreign arrivals last week were larger than for some time previously, and the coal trade will doubtless soon assume its usual activity.

MIDLAND COUNTIES.

Derbyshire.—The position of the iron trade is somewhat better, but there is nothing to indicate a state of activity. There is a general dulness in the hardware and metal trades, which is increased by the near approach of the Great Exhibition, parties being disposed to wait that time with a view of getting hold of the newest inventions. There is an increased demand for plates for shipbuilding, and Messrs. Brown and Co., of Sheffield, have received the order for the cupola plates recently adopted by the Government. There is a greater demand for rails for our home lines; and from what is doing on the Continent we may expect shortly to receive large orders from our colonial possessions. The coal trade is very dull, and in many of the colliery districts there is great privation experienced, much greater than has been known for years past. Some of the colleries are not working more than half-time, and this, coupled with the fact that wages have been reduced 10 per cent., makes the condition of the operative collier a very depressed one. So long as the cotton and woollen trades are depressed there is no hope of improvement. There is not half the quantity of coal being sent from Derbyshire to the manufacturing districts this year as compared with the last.

South Staffordshire.—An admirable tone continues to pervade the iron market of South Staffordshire. In Birmingham, more particularly, this was quite perceptible. On every hand there seemed a conviction that business would soon show a very decided improvement. A heavy demand is sure to be soon experienced in this country for iron and hardware for all continental markets, should events fulfil the expectations that are now being indulged in relative to the working of the Anglo-French Commercial Treaty. And, as has been anticipated, the past three months' trade of the ironmasters of England, with the consumers of the metal that they produce, is eminently stimulative of the warmest anticipations. All this is totally independent of the great work in which we have begun to be engaged, and which our own witty historian of the present day has so admirably caricatured in his cartoon for this week. Truly Vulcan is arming Neptune, and as heretofore that Vulcan must ever be Great Britain. "Come on who dares or can, long ranges or close quarters, we're his men." Many a finger in South Staffordshire is itching to take a prominent part in the conflict, but prudence is more than ever a distinguished feature of the conduct of the ironmasters of this district. Plates have been produced here that have been reported very favourably upon by the Iron-plate Committee, inasmuch as the face of the plates received a 40 lb. shot at one hundred yards without showing any sign of cracking; but the back, which seemed to be harder than the front, cracked across. Then the welding was not complete, but it had been better done than has been the case with much of the iron sent to the committee. Defective welding is spoken of by Captain Dyer, the secretary to the committee, "as invariable in all plates," but, he adds, that in the specimens of which he was writing—was furnished by Mr. S. Millington, of Tipton—this defect was "not nearly so apparent as in many the committee have tried." A conviction is felt here even more strongly than it was felt last week, that in this district we can produce iron

that shall be above successful competition, if the authorities will only pay us a fair price for our stuff; and there is little doubt but, so soon as the question assumes a more definite shape, South Staffordshire will enter the market with vigour, and produce iron adapted to shifting land fortifications as well as to floating batteries, for the day of land fortifications upon which guns may be moved to sweep all points is not yet at an end. Perhaps, however, a stronger influence for good than any fact that we have yet recorded is being exercised by the conviction that is gaining upon all minds that we have arrived at the end of one of those epochs in the history of commerce which signalise the commencement of a new epoch, with an increase of trade and a rise of prices that will continue to move in a right direction until, some five or six years hence, the culminating point will have been reached, and we shall begin again to retrograde, till at the last two or three years of the decade we find ourselves as we have recently been, silting at the bottom. Although there has been a slight fall in the week in Scotch pigs, yet the great rise of the past month in that most sensitive article of commerce is indicative that it is now being used for purposes of investment by capitalists. Coal, of first-class samples, is in good demand at the leading houses.

NORTHERN COUNTIES.

Northumberland and Durham.—The *Colliery Guardian* gives the following review of the trade of this district towards the end of this month. This being Easter week, and the holidays interfering with business somewhat, there is nothing remarkable to report about the condition of trade in this neighbourhood. We contrive to keep up the increased activity, and the aspect of commercial affairs is decidedly better than it has been at any previous time this year. The coal trade is, however, flat, only the household and coking collieries doing much business. The gas-coal collieries, which have been moderately well employed all winter, are feeling the effects of the long-light evenings, for, as the days extend, their working-days shorten, and in a few weeks they will arrive at their slackest season. A local paper, in speaking of the rapid development of the Cleveland district, says:—"All works in the neighbourhood are fully employed, and as the year advances no doubt the export trade will increase. One fact worthy of note in connection with the trade in this district is, that whereas in 1860 only 30,000 tons of iron were shipped to France, yet in 1861 somewhat over 90,000 tons were despatched to that country, showing the benefit the ironmasters and trade in general of this district have derived from the French treaty, which has in a great measure compensated for the falling off of the American trade Two of the principal firms are at present engaged in the execution of large orders for railway chairs for the South of France, and the shipments that have been made so far as the year has advanced, have principally been to that country: so that there is every reason to expect that this year will fully come up to last, if not surpass it, and with the advance iron has got this last week or two, it will encourage the manufacturers to push their trade more in this district. A Staffordshire firm, wishing to share in the prosperity enjoyed by the Cleveland district, is said to have purchased 200 acres of land at Grosmont, near Whitby, for the purpose of erecting blast furnaces, the ironstone in that district being supposed to be rich, but not so thick in the strata as the more northern parts of the Cleveland bed, which has its terminus near Middlesbro'. There have already been some unfortunate works erected in this district at Rosedale. The blast furnaces and engine-house, built on a bad foundation, gave way and fell over. We hope the Messrs. Bagnall, who are the purchasers of this new royalty, will be more fortunate than their predecessors. Mr. Snowdon, late of the firm of Snowdon and Hopkins, Tees-side Iron Works, Middlesbro', Mr. Leeman, solicitor, York, deputy-chairman of

the North-Eastern Railway Company, and Mr. Muschat, coal-owner, are stated to have purchased a plot of land adjoining the above works, for the purpose of erecting steel works. Whether these gentlemen intend to manufacture steel in all its different kinds, similar to some of the large Sheffield firms, or intend merely to manufacture steel plates for ship and boiler purposes, we are not in a position at present to say. Now that there has become such a demand for armour plates, and the resources of the Cleveland district being fully able to cope with undertakings of this kind, should those gentlemen go into this trade we see no reason why they should not succeed, especially as we know that the Cleveland plates are quite able to bear the tests submitted to them by the Government in all their different forms." The exports from the Tyne last week included 39,790 tons of coals; 2,341 tons of coke; 3,699 cwt. of iron, and 10,325 cwt. of alkali, being an increase of 5,334 cwt. in the shipments of alkali, and a decrease in the shipment of coals of 1,153 tons; coke, 180 tons; iron, 6,005 cwt. Among the imports were 16 tons of scrap-iron from Oporto, and cargoes of pit props, &c., from Christiansand and Arendahl.

Yorkshire.—Some years ago a poor fisherman travelling in the neighbourhood of Rosedale, Yorkshire, found a stone of a peculiar character, which he gave to some gentleman who caused it to be analysed, and found it to contain an immense proportion of rich and valuable iron ore. This was the discovery of the now well-known Rosedale Magnetic Ore, of whose extent and duration no calculation can be made. Not many years since a company leased 8,000 acres of land in Rosedale, and commenced to work out the mineral wealth of the district on a large scale. They have been very successful, and at the present time their usual output is from 10,000 to 16,000 tons per month, or a quantity capable of producing from 60,000 to 80,000 tons of pig-iron per annum. The ore is of three principal varieties—the brown, yielding 51½ per cent.; the dark blue, 43 per cent.; and the light blue, 39 per cent. of iron. One of their chief customers is Mr. Morrison, of Ferry Hill furnaces, and the company contract to supply this gentleman with ore yielding on the average 44 per cent. of iron, which is a trifle under the average percentage of the varieties named. Last week a number of gentlemen, including directors of the North-Eastern Railway, and gentlemen connected with the iron trade, had a trip along the newly-opened Rosedale Branch Railway to visit the works of the company. Amongst them where the Lord Mayor of York (Mr. Leeman); Alderman Hartley, of Sunderland; and J. Pulleine, Esq. (directors of the North-Eastern Railway); Mr. Morrison, of Ferry Hill; Alderman J. L. Bell, Mr. John Rogerson, Mr. John Cochrane, and Mr. Millar, of Newcastle; Mr. Cail, the Rosedale Branch contractor; Mr. Sheriff, Worcester; Mr. J. H. Leeman, and Mr. Isaac Harties, of the Rosedale Mining Company; Captain O'Brien and Mr. Cabry, York; Mr. Stobart, Mr. Webster, and Mr. Ord, of Sunderland, and others. Arrived at the mine the party entered, traversed the galleries, headways, and bords, and at the principal workings of the magnetic ore applied the magnet, and held the iron ores in suspense. After the inspection the party dined together at Rosedale, under the presidency of the Lord Mayor of York.

SCOTLAND.

Mr. Ferrie having declined the appointment of Government Inspector of coal-mines for the eastern division of Scotland, the Secretary of State has conferred it on Mr. Ralph Moore. This gentleman having satisfactorily passed his examination under Mr. Warington Smyth, has entered upon the duties of his office.

A very valuable series of papers has appeared for some weeks past in the *Colliery Guardian*, from the Scotch correspondent of that Journal. Some of these papers are really very able essays.

COLONIAL AND FOREIGN.

We have received the Government reports, papers, and acts on the Nova Scotia gold-fields, but too late for notice this month. We have also received some private communications on these districts, of which we will give an abstract next month.

A Company called the South Greenland Mining Company has been formed for the purpose of working mines of copper, tin, lead, and other minerals in South Greenland. Mr. W. C. Vivian, the mining broker (Vivian and Reynolds) is the engineer.

A company has also been formed for working the Great Copper Lode of Huacayvo (Mexico); Mr. G. C. Hockin is the Chairman, which may be considered a guarantee of the *bona fides* of the concern, as Mr. Hockin is a director of the Anglo-Mexican Mint, and well acquainted with that country.

The Labuan Coal Company have issued a report to their shareholders containing a very satisfactory statement from Mr. Sinclair, their new manager, to the effect that it was expected to get coal ready for delivery at the jetty to vessels calling at the island during the present month, and that he has no doubt that from the present seams 100,000 tons can be worked yearly for ten years if the requisite amount of labour can be procured.

At a meeting of the New Granada Company, a report was presented, stating that the new manager had arrived at the Frontino Mines in May last, and that his report upon that property corroborates the favourable opinions of the directors as to its value. The political disturbances in the republic, however, have not only interfered with industrial operations, but have likewise almost entirely stopped communication between the coast and that part of the country where the company's business is carried on, and suspended for many months the forwarding of remittances from the mines. The produce of ore has also been diminished in some degree, from the impossibility of transmitting gunpowder and other necessary stores. The cost of working, on the other hand, has not been lessened in nearly the same proportion. The agents continue to speak highly of the intrinsic value of the company's property. With a view to the introduction of an improved system of working and for other purposes, the directors were authorised to borrow 5000*l.* in debentures.

UNITED STATES.

The *United States Railroad and Mining Register* gives the following, on the coal trade of the United States:—During the official and navigation year, 1861, the six outlets to the general tidewater market, from the three anthracite regions, divided the coal tonnage forwarded, in these proportions, to wit:—

	Tons.	
Philadelphia and Reading Railroad	1,460,832	
Schuylkill Canal	1,183,570	
Total from Schuylkill region		2,644,402
Lehigh Valley Railroad	743,672	
Lehigh Canal	994,705	
Total from Lehigh region		1,738,377
Delaware, Lackawanna, and Western R. R.	1,104,319	
Delaware and Hudson Canal	1,356,301	
Total from Lackawanna region		2,460,620
Total tonnage six lines from three regions		6,843,399

The percentage of this grand aggregate forwarded from each region was:—

From the Schuylkill region	38·64 per cent.
From the Lehigh region	25·40 per cent.
From the Lackawanna region	35·96 per cent.
	100·00 per cent.

To the first of July, in the season of 1861, there were forwarded to market over the Delaware and Hudson Canal 432,028 tons, the whole of these shipments having occurred in the months of May and June. If, this present year, parties interested in the transport of coal – for when loss is incurred it usually falls upon the transporters—had combined together and contracted with the Delaware and Hudson Canal Company for all the coal produced from the mines of said company, and forwarded over its canal in the months of May and June, at a fair and full price, then said company, upon such price as a basis, could have imposed a remunerating rate of toll upon the tonnage shipped for the Pennsylvania Coal Company; the general market would thus have been protected and the entire trade would have prospered throughout the season. But the opportunity was permitted to slip by, and, as a consequence, all the carriers to the market in which the competition prevails, are transporting coal at reduced rates, or under a schedule of drawbacks which diminish net income. Moreover, as the great carriers now understand and appreciate their relative positions in and towards the common market, it seems to us they might agree among themselves to bind each line not to forward coal tonnage in excess of a prescribed percentage of the aggregate supply. The six carriers can surely agree upon the quantities that shall be forwarded, even if they cannot control prices in the market. And, as upon stipulated quantities they could impose charges that would assure a just return and measure of income, the shippers (being thus cut off from the reduction in transportation expenses) would be constrained to keep up the prices of coal in the market, and make the consumer pay all expenses justly and fairly a part of the cost of production; whereas now, in the event of embarrassment in the market, the shipper appeals to the carrier to reduce the charge for transportation, so that he may furnish coal to its consumer at prices below cost, the carrier parting with a profit equal to the reduction made, and which tends to the sole benefit of the consumer, who should pay a price covering all charges accrued against the article on its arrival in the market. We believe if the six carriers would treat upon the quantities as a basis, in lieu of prices, they could control the market; for by rail and canal quantities could be forwarded in trains and through locks, according to stipulation laid down in a compact; then, if operators and dealers would cut under in prices, the reduction would be their own loss, and would not, as now, come off the carrying lines. Besides, as the market could not be overstocked under the plan proposed, the general tendency of the operations in the market would be towards a maintenance of remunerating prices, for dealers are not over fond of doing business at a loss to themselves, especially where and when it is within the compass of their efforts to realise gain and character out of the same transaction.

Metal Markets.

THE following weekly reports from Messrs. Von Dadelszen and North, show the position of the metal market during the month:—

April 3.—COPPER.—The market has become easier, and 10¾d. is the smelters' price, while some second-hand lots are to be had at 10½d. Foreign was affected in the same way as English, and the price of Burra advanced from 94*l*., which was the very lowest, to 97*l*. 10*s*.; the market is now a shade easier, and there are sellers at 97*l*. Kapunda is held for 98*l*.; Spanish, 90*l*.; and Chili 88*l*. to 89*l*.

TIN.—In English tin official prices are maintained, but there has been and still is underselling, the demand being slack. Straits has only been sold in small quantities for export and consumption at 117*s*. for fine; there are now sellers of this, but no buyers of any quantity. Little or no business

has been doing in the market for Banca; the price is nominally 125*s*. In Holland very little done—f. 73½ the present price.

TIN PLATES.—There have been extensive shipments from Liverpool, and makers continue to be very fairly supplied with orders, but the prices are low, and future prospects of the trade bad. We quote charcoal from 26*s*. 6*d*. to 28*s*. 6*d*., and coke 22*s*. to 24*s*., in London; 6*d*. less for delivery in Liverpool.

LEAD.—The market and demand have been very dull, and prices are on the decline.

SPELTER.—The market is now dull, but not lower in price; for Hull parcels 18*l*. 5*s*. is the price.

April 9.—The dull state of the metal market since our last report has increased rather than diminished, and with the exception of Scotch pig iron, which has been very excited, other metals have all a more or less downward tendency.

IRON.—Welsh bars are in moderate demand at 5*l* f. o. b. Wales, and at about 6*l*. per ton here, and 5*l*. 15*s*. to come forward. Staffordshire very quiet. A very large speculative business has been done in Scotch pig iron; on Monday last as high as 54*s*. cash was paid, but yesterday as low as 53*s*. was accepted, at which it closed rather flat.

COPPER.—For manufactured 10¾d. is firmly asked, but cake and tile are obtainable at 95*l*. Foreign is easier. Burra has been done at 96*l*., and still obtainable at it. Kapunda 97*l*. nominal. Chili 88*l*. to 89*l*.

TIN.—English dull, the demand slack. Foreign is lower. We have sellers of straits at 115*l*. Buyers looking on. Banca is nominally 125*l*. The Dutch market dull at 73f.

TIN PLATES difficult to dispose of, the American market being overstocked; the prospects are any thing but bright for manufacturers.

LEAD remains very dull; good English pig 19*l*. 10*s*. to 20*l*.

SPELTER.—The business done hardly calls for any remark, holders at 18*l*. 10*s*. for parcels on the spot here, but 5*s*. less would not be refused. Hull lots 18*l*. 5*s*. to 18*l*. 7*s*. 6*d*.; special brand 18*l*. 10*s*. W.H. 19*l*.

April 16.—There is no feature of interest to report in the metal market. Dulness has predominated, the demand has materially fallen off, and if it were not for the cheapness of money, which enables holders to look out for better times, several kinds of metals would have further receded in value.

COPPER.—Both English and manufactured can be bought under official quotations, and although the last telegram from India brought better amounts, it has as yet had no effect on this market. In Burra, owing to lower prices, a good business has been done at 95*l*., at which there are still sellers—Kapunda is held for 96*l*., Chili in Liverpool 88*l*. to 89*l*.

TIN.—English in fair demand, without alteration in value. Straits is very flat with sellers at 115*l*.; buyers shy. Banca nominally 124*l*. The Dutch market, after touching 72f., was nominally recovered to 73f.

TIN PLATES remain dull of sale, prices unaltered.

LEAD.—No change for the better to be reported.

SPELTER.—The transactions have been very few, but prices are fairly maintained. We quote spot here 18*l*. 7*s*. 6*d*. to 18*l*. 10*s*. Hull parcels have changed hands from 18*l*. 5*s*. to 18*l*. 10*s*.; according to brand, W.H. 19*l*.

April 23.—The Easter holidays have somewhat interfered with the regular course of business, but, independent of this, the metal market has not shown any signs of reanimation. Welsh bars are in a fair but moderate demand, at about 5*l*. per ton f. o. b. in Wales; from 5*l*. 17*s*. 6*d*. to 6*l*. f. o. b here.

COPPER.—The last Indian advices are somewhat better for this metal, but shipping orders are below present prices. We quote manufactured at from 10½ to 10¾. Tough cake and ingot 94 to 95. Burra has been sold as low as 94*l*. 10*s*., but it is now held for 95*l*. Kapunda nominally 97*l*. Chili 87*l*. to 88*l*. in Liverpool.

TIN.—English was officially reduced on the 21st inst. 3*l*. per ton, both for refined and common. Foreign, although it has not gone down quite to the same extent, is very flat. Straits can be had at 114*l*., and we did hear of 113*l*. being accepted for an export order. Buyers are still very cautious. Banca being held for 124*l*. effectually prevents any business. The Dutch market is flat at 73f. sellers.

TIN PLATES are very dull of sale; prices from New York come very low, which will prevent any export of magnitude.

LEAD is dull, without any change in value.

SPELTER has been very quiet, but firmer. Holders ask 18*l*. 10*s*. for parcels on the spot here; a limited business done at 18*l*. 7*s*. Some favourite brands in Hull have changed hands at 18*l*. 10*s*., at which we close sellers; buyers 5*s*. less. WH 19*l*.

Metallic-Ore Markets.

TIN.—During the last month the standards for black tin have again declined 2*l*., which makes a reduction of about 32*l*. per ton on refined tin during the past two years. The standards now stand at—

Refined	£102—105
Common	101

The stocks are reported as heavy, and the market remarkably dull.

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard, have been as follows:—

Date.	*Tons.*	*Produce.*	*Fine Copper.* Tons. cwt.	*Price per ton.*	*Standard.*
Mar. 27.	4,108	6⅜	262 6	£5 8 0	£123 14 0
Apr. 3.	3,907	6	234 10	4 17 6	127 5 0
„ 10.	2,558	7	179 8	5 17 0	122 12 0
„ 17.	5,286	6¼	328 10	4 19 6	124 7 0

According to the standard calculations, on March 29, there was a decline of 1*l*. 10*s*. or 1*l*. 12*s*. in the standard compared with the previous sale. At the sale of April 3, there was an *advance* of 1*l*. or 1*l*. 6*s*. At the sale of the 10th, according to the *Mining Journal*, there was a *decline* of 10*s*., but according to the *West Briton*, the standard remained stationary. At the sale of April 17, there was a decline of 1*l*. 2*s*. or 1*l*. 5*s*.

LEAD.—Comparing the sales of lead ore for the month with those of the former month, there appears a decline ranging from 10*s*. to 15s. per ton.

London Share-Market.

THERE has been a very large amount of business transacted during the past month. Notwithstanding the interference of the usual Easter holidays, money has become tighter from the increasing demands for Foreign loans, which have absorbed a large portion of the unemployed capital.

The details of the operations in shares will be gathered from the following:—

Alfred Consols offered very freely at a nominal price.

Cook's Kitchen shares have been more offered for some days past; they are now weaker in character, but the mine is reported to be looking most favourable.

Clifford Amalgamated have been steady at 29-31.

Camborne Vean declined to $1\frac{3}{8}$-$\frac{1}{8}$.

Carn Camborne has remained very steady at 11/. to 13/.

Craddock Moor very scarce, only one or two shares having changed hands: the price is firm at 29-31. Devon Great Consols have been much sought after, but holders do not seem inclined to part with their shares, as the many orders to buy have been returned unexecuted: they close at 420-30. East Basset continues dull in character, at lower prices. East Caradon, after touching 40, receded again to $38\frac{3}{4}$-$9\frac{1}{4}$, at which they close. A very large amount of business has been done in these shares at various prices between 35 and 40: the latest reports from the agents give the valuations of the ends as follow:—the 50 east, 70*l.* per fm.; 60 east, 50*l.*; Fawcett's lode, 15*l.*; new lode 8*l.*; 60 west, worth 40*l.* per fm.

East Carn Brea have been largely dealt in at $12\frac{3}{4}$-$13\frac{1}{4}$, the mine is looking promising for further improvement. East Grenville, steady at 30*s.*-32*s.* 6*d.* Great Fortune have been in great request, and close very firm at 25-6. Great South Tolgus have been in demand and closed firm.

In Herodsfoot only a moderate amount of business transacted, the price remains steady at 37-8. Hingston Down shares have been very flat for some time past, with scarcely any business doing: Marke Valley remained very firm and steady at $10\frac{1}{8}$-$\frac{1}{4}$; the mine continues to look well, and the samplings are kept up without intrenching on the reserves. New Seton in considerable request, and advanced to 80-90. North Downs declined to $3\frac{3}{4}$-4, there have been numerous dealings in these shares throughout the month, but there has been a preponderance of sellers. North Basset scarcely inquired for. North Treskerby have fluctuated a great deal, and close 23-4. North Crofty advanced to $3\frac{1}{4}$ buyers, but close $2\frac{1}{4}$-$\frac{1}{2}$, inquired for.

In Providence shares, there has been very little business done during the month; the price has become lower towards the close, being 40-1. Rosewall Hill and Ransom have been largely dealt in, but closed rather weak at $3\frac{1}{4}$-$\frac{3}{4}$. South Tolgus occasionally sought after. South Caradon are firm at 335-40, with a limited number of transactions. South Frances weak in character, at present quoted $97\frac{1}{2}$-$102\frac{1}{2}$. Stray Park very firm at 31-3.

Tincroft greatly in request, and shares advanced to $12\frac{1}{4}$ buyers, but declined again to $10\frac{1}{2}$-$11\frac{1}{2}$, at which they close. Tamar silver lead, very dull at present. West Caradon weak at 30-2. West Rose Down are eagerly picked up by investors. The prospects of this mine are very encouraging, as the sett adjoins Marke Valley; the shares are now 15-16. West Seton weak. Wheal Grylls have advanced to 33-5, the supply of these shares has been very scanty for some time past. Wheal Bassets, $97\frac{1}{2}$-100 with a little inquiry. Wheal Grenville after remaining quiet at $2\frac{5}{8}$, have recovered, and advanced to $3\frac{1}{2}$ buyers, owing to an important discovery of the winze sinking below the 90. Wheal Uny firm $7\frac{1}{2}$-$\frac{3}{4}$. In Wheal Ludcott a very large number of shares have changed hands at advanced prices; they close $5\frac{1}{4}$-$\frac{3}{4}$. Wheal Margaret rather weaker, at the close 45-46. Wheal Mary Ann, very flat. Wheal Setons have been dealt in to a considerable amount, they close 133-5. Wheal Trelawny close weaker than they have been, viz., 16-17. Wheal Basset dull, 11-12. Wheal Unity have been in request, and close 13/.-14/.

South Phœnix shares have been in request during the last few days, and have improved to $2\frac{3}{4}$-$3\frac{1}{4}$; this mine is situated near Marke Valley and West Rose Down, and a cross-cut is at present being driven to intersect the Marke Valley lodes, which, it is expected, will occupy about six months yet.

In Welsh mines there has been a good business done. Bryn Gwiog, 27 buyers. At Billins, the lode in the shaft sinking west is producing good lead one ton per fm., and improving; the shares are 17-18 Longrake rather quiet, 12-14; at the meeting a call of 1*l.* per share was made. North Minera with very few inquiries.

In foreign mines there has been an average amount of business done in the Stock Exchange. St. John del Reys have declined to 52-3, and many transactions have taken place. United Mexican remain tolerably steady at present at 7-$\frac{1}{2}$. Great Northern Copper have declined and closed. East del Rey steady at $1\frac{1}{2}$-$\frac{3}{4}$. Port Philip, 1-$\frac{1}{8}$, with occasional dealings. Scottish Australian have been in considerable request, and close at an advance $2\frac{1}{8}$-$\frac{3}{8}$. North Rhine rather improved owing to better reports from the mine. Maraquita have been dealt in at $\frac{7}{8}$. Dun Mountain, firm at $1\frac{1}{8}$. General Mines steady, 22-24. Worthing, not much doing, $\frac{1}{2}$ to $\frac{5}{8}$. Bon Accord, very dull at $\frac{1}{4}$-$\frac{1}{2}$. Fortuna, 2-$2\frac{1}{2}$. In Cobre Copper, Linares, Kapunda, Brazilian, Lusitanian and Pontgibaud very little business doing, and scarcely any variation in prices.

Tuesday, *29th April*, 1862, 4 P.M.

The following are the closing prices furnished by Messrs. Webb and Geach:—

The usual fortnightly settlement has somewhat interfered with to-day's business, the markets have not therefore been very active. Nevertheless, there was a fair business done in East Caradon, Great Fortune, North Downs, Wheal Seton, Marke Valley, East Carn Brea, and South Phœnix.

Carn Camborne, 12/. to 14/.; Camborne Vean, $1\frac{3}{8}$ to $\frac{1}{2}$; Cook's Kitchen, 33 to 34; Devon Great Consols, 420 to 30; East Basset, 41 to 3; East Caradon, 39 to $\frac{1}{2}$; East Carn Brea, $12\frac{3}{4}$ to 13; East Grenville, 30/. to 32/6; East Jane, 2 to 3; Great Vor, $6\frac{3}{4}$ to 7; Great Fortune 26 to $\frac{1}{2}$; Herodsfoot, 37 to 38; Marke Valley, $10\frac{1}{8}$ to $\frac{1}{4}$; New Seton, 30 to 90; North Downs, 37/8 to 4/8; North Treskerby, 23 to 24; North Crofty, $2\frac{3}{8}$ to $\frac{1}{2}$; Providence, 40 to 42; Rosewall Hill, $3\frac{1}{2}$ to $3\frac{3}{4}$; Rosewarne United, 19 to 21; South Phœnix, $2\frac{7}{8}$ to $3\frac{1}{8}$; South Caradon, 335 to 40; South Frances, $97\frac{1}{2}$ to 100; Tincroft, $10\frac{1}{2}$ to 11; West Caradon, 31 to 32; West Rose Down, 14 to 16; West Seton, 260 to 70; Wheal Grylls, 32 to 34; Wheal Basset, 95 to 100; Wheal Grenville, $3\frac{1}{2}$ to $\frac{5}{8}$; Wheal Uny, $7\frac{1}{2}$ to $\frac{3}{4}$; Wheal Kitty, Lelant, $10\frac{1}{2}$ to $11\frac{1}{2}$; Wheal Ludcott, $5\frac{1}{4}$ to $\frac{1}{2}$; Wheal Margaret, 45 to 6; Wheal Mary Ann, 11 to 12; Wheal Polmear, 17 to 19; Wheal Seton, 133 to 5; West Tolgus, 30 to 5. *Foreign Mines*:—East del Rey, $\frac{3}{8}$ to $\frac{5}{8}$ prem.; St. John del Rey, 52 to 4 prem.; United Mexican, $7\frac{1}{4}$ to $\frac{1}{2}$; Port Phillip, 1 to $\frac{1}{8}$; Gt. Northern, $\frac{3}{8}$ to $\frac{1}{4}$ dis.; Santa Barbara, $\frac{1}{8}$ to $\frac{3}{8}$ dis.; Capula, $\frac{1}{8}$ dis. to $\frac{1}{8}$ prem.

Provincial Share Markets.

DUBLIN.—The following report is condensed from the *Mining Journal*:—Towards the end of March, the Wicklow Copper Mining Company shares slightly improved, from 50*l.* 15*s.* to 51*l.*, at which price they were in request. The Mining Company of Ireland shares a trifle lower, 18*l.* 17*s.* 6*d.* being offered, and holders demanding 19*l.* 5*s.*, an abatement of 2*s.* 6*d.* on last

quotation. General Mining Company for Ireland shares changed hands at 4*l*. 10*s*. leaving off sellers. Business was done in Connorree shares at 33*s*. Great excitement was got up in favour of Carysfort shares, which rose from 9*s*. 6*d*. to 12*s*., and have since advanced to 20*s*., but fallen back to 15*s*. (15*s*. paid), or par. Sales in fully (2*l*. 10*s*.) paid up shares where effected at 1*l*. 15*s*., or at an improvement of 10*s*. per share, but still at a discount of 30 per cent.

In the beginning of April, the Wicklow Copper Mining Company's shares were fully 1*l*. lower than last prices of 50*l*. 15*s*. to 51*l*., from which they have gradually fallen to 49*l*. 12*s*. 6*d*., buyers. The steadily progressing prosperity of the Mining Company of Ireland, whose directors and managers, like those of the Wicklow Copper Mining Company, pay more attention to the genuine improvement of their mines and general affairs than to ruling the share market, prevents the prices of their shares fluctuating much; they closed 18*l*. 17*s*. 6*d*., buyers, and continue in request at that price, with a tendency for a slight rise. Connorree shares are heavy, and so are Carysfort.

Further on in the month, Wicklow Copper Mine Shares were nominally quoted at from 45*l*. to 47*l*. The Mining Company of Ireland shares suffered least from the prevailing dulness in mine securities, and were readily bought at a fraction under 18*l*. for cash, and at 18*l*. for new account. The prospects of these mining properties render investments in them at the present price safe and promising. Carysfort shares offered at 13*s*. 6*d*., and Connorrees easily procured at 31*s*. 6*d*. In General Mining Company for Ireland shares little or no business doing.

Later in the month, the announcement of "no dividend this half-year" by the Directors of the Wicklow Mine Company, cast a temporary gloom upon the shareholders, and the price of the shares fell as low as 44*l*. But on quietly reviewing the excellent prospects for the future, buyers became predominant, and shares rose again to 48*l*. There will, of course, be a variety of opinions as to the time the American war will continue, and the price of these shares will fluctuate accordingly; thus they have again fallen back to 47*l*. 10*s*., sellers. At Carysfort, an improvement has taken place in their Ballintemple Lead Mine, which holds out promises of proving profitable; but the produce is as yet small, nevertheless it has tended to give firmness to the price of the shares, steady at par, or 15*s*. In General Mining Company for Ireland shares several transactions at 4*l*. 12*s*. 6*d*, and 4*l*. 15*s*. sellers. A rumour of Knockmahon Mines not looking so well as hitherto had a depressing effect on the shares of the Mining Company of Ireland, which fell at one time to 16*l*., from which they, however, recovered to 17*l*., at which all would be taken that offered. Connorree shares flat.

Towards the end of the month, a few transactions took place chiefly in Mining Company of Ireland and Wicklow Copper shares; the former touched 17*l*. 10*s*., but receded to 17*l*. 2*s*. 6*d*., freely taken at 17*l*.; the latter, or the Wicklow Copper Mining Company's shares, moved back to 46*l*., in request. A few transactions took place in Carysfort shares (last call, or 20*s*. paid), at 19*s*., or 5 per cent. discount. Connorree shares were ineffectually offered at 32*s*. In General Mining Company for Ireland shares no business noted. At the Wicklow Copper Mining Company's ordinary half-yearly general meeting, on Wednesday, the directors' reports and accounts, made up to March 1 last, were laid before the shareholders. The Chairman stated to the meeting that there had recently been symptoms of improvement in the alkali trade in England, and he trusted it would ere long compensate the shareholders for their temporary sacrifice of a dividend. Mr. Octavius O'Brien, to whom a vote of thanks for important services rendered to the company was passed, suggested that the establishment of chemical works by this company would prove a source of profit, and have at least the effect of checking the extraordinary fluctuations in the prices of sulphur.

EXTRACTS FROM MINING CIRCULARS.

From Messrs. Webb and Geach, 8, *Finch Lane, London.*

There has been an average amount of business transacted during the week, notwithstanding the interference of the Easter Holidays. The demand has, however, been confined to a few mines, such as East Caradon, Marke Valley, Ludcott, East Carn Brea, Cook's Kitchen, North Treskerby, North Downs, North Crofty, Providence, South Caradon, Devon Consols, Stray Park, Tincroft, Wheal Grenville, Wheal Uny, Wheal Polmear, Wheal Margaret, and Wheal Seton, in each of which there has been a fair amount of business transacted. East Caradons remain very firm, although the highest prices of last week have not been maintained, as they then touched 40*l.*, but have receded a little, and close 38¼-¾. Comparatively speaking, there are scarcely any shares offering on the market, as the public continue to buy them for investment, and thus the supply is very meagre. Marke Valleys have advanced since the meeting, and are now tolerably steady, at 10⅛-¼. East Carn Brea continues firm, at 12¾-13. At the meeting the cash account showed a balance of 186*l.* against the mine, but the estimated receipts and expenditure for the next two months showed a balance of about 2,200*l.* in favour of the adventurers. The report of the agent pointed out the favourable progress made in the various workings during the past two months, and also expressed the great confidence felt by them in the future prospects of the mine. Wheal Ludcotts have been in rather extraordinary request, and have risen to 5½-6. The accounts presented at the last meeting were considered highly favourable, and the mine is reported to be making good progress. Cook's Kitchen have been more offered, and the price has declined to 33-34. North Treskerby occasionally inquired for, they remain tolerably steady, at 23-4. North Downs very flat, and declined to 3⅝-⅞, but close firmer. The market seems to be chiefly sellers of these shares, hence the drooping tendency. North Crofty, having advanced to 3¼-⅜, have become weaker, and close 2⅜-⅝. Providence steady, at 41-2. South Caradons very scarce, 332½-7½. Devon Consols also inquired for, but no sellers at present on the market. Stray Parks, 32-4, with fair business doing. Tincroft suddenly advanced to 12-13; they close 11½-12½, with more buyers than sellers. Wheal Grenville remain firm, at 3-¼, shares very scarce for immediate delivery. Wheal Uny inquired for, 7½-8. Wheal Polmears have been inquired for during the past few days, but at present there are no sellers on the market; the mine is said to be looking very favourable; they close 18-20. Wheal Margarets have been largely dealt in, and close 45¼-¾, with a fair demand and supply. Wheal Setons close firm, 134-6.

From Messrs. Watson and Cuell, 1, *St. Michael's Alley, Cornhill.*

During the past week, business has again been very active. East Caradon, after rising to 39½, have dropped to 38 38½, and a large business doing. East Carn Brea advanced to 13⅛ 13¼, but dropped to 13, sellers, immediately after the meeting yesterday. Tincrofts have been in a great demand, at 11½ to 12½. Devon Consols in great demand at 420, but no shares offering. Tolvadden, after reaching 4¾, dropped to 4⅛ 4⅜, at which price they close. Grylls firm, at 33. Rosewall Hill firm, at 3⅞, buyers. Wheal Seton continue in demand, at 133. North Downs leave off flat, at 3¾. Cook's Kitchen still inquired for. Great Fortune advanced on Monday to 27, but leave off flatter at 25, sellers. North Phœnix in demand, at 5. Sithney Carnmeal find buyers at 30/, after being flat at 10/, sellers. Grenvilles rather weaker. East Grenville firm, at 31. Redmoor in good demand. West Rose Down in demand, at 15—shares are very scarce. West Caradons have been freely offered at 31½. Alfred Consols flat, at 5/, sellers. Altogether, a large business is doing, and the market likely to continue active.

Prices Current of Metals.

From Messrs. JAMES and SHAKSPEARE'S, 10, Austin Friars, E.C.

			Per Ton.			
IRON	Bars	in Wales ..	£5 0 0	@	£5 5 0	
	„	„ Liverpool	....		5 15 0	
	„	„ London	6 0 0	„	6 5 0	
	Nail Rods	„ Wales .	5 12 6	„	5 15 0	
	„	„ Liverpool	6 10 0	„	7 0 0	
	„	„ London	7 5 0	„	7 15 0	
	Hoops (Staffordsdire)	„ Liverpool	7 15 0	„	8 10 0	
	„ „	„ London	8 5 0	„	8 15 0	
	Sheets „	„ Liverpool	8 10 0	„	9 5 0	
	„ „	„ London	9 0 0	„	9 15 0	
	Bars „	„ Liverpool	7 0 0	„	8 0 0	
	„ „	„ London	7 10 0	„	8 10 0	
	Scotch Pig (No. 1. g.m.b.)	the Clyde	2 12 6	„	2 13 0	
	Rails	in Wales	5 5 0	„	5 10 0	
	Russian	C.C.N.D.	....		....	
	Swedish—Hammered—	large sizes	11 10 0	„	11 15 0	
	„ „	Indian sizes	11 10 0	„	11 15 0	
STEEL	Hammered—faggot		....		16 10 0	
	„ in kegs ¼ and ⅛ in...		....		15 10 0	
COPPER	Australian and other *fine* Foreign		....		95 0 0	
	Foreign Slab, for Prod. 96 per Cent.		....		88 0 0	
	English Tile and Tough		95 0 0	„	98 0 0	
	„ Best selected		98 0 0	„	101 0 0	
			Per lb.			
	„ Sheets, Sheathing and Rod		10¾*d.*	„	11*d.*	
	„ Flat Bottoms		11¼*d.*	„	11½*d.*	
YELLOW METAL	Sheets, Sheathing and Rod		8½*d.*	„	9*d.*	
			Per Cwt.			
TIN .... English ..	Common Blocks and Ingots		....		114*s.*	
	„ Bars (in barrels........		....		115*s.*	
	Refined		....		119*s.*	
Foreign ..	Straits		....		113*s.*	
	Banca		121*s.*		122*s.*	
			Per Box.			
TIN PLATES at Liverpool 6*d.* Less	Charcoal IC		28*s.*	„	29*s.*	
	„ IX		34*s.*	„	35*s.*	
	Coke IC		22*s.*	„	23*s.*	
	„ IX		28*s.*	„	29*s.*	
			Per Ton.			
LEAD..........	Sheet		....		20 10 0	
	Pig—W.B.		21 0 0	„	21 5 0	
	„ Ordinary brands		19 15 0	„	20 0 0	
	„ Foreign, soft..........		....		19 0 0	
	Red		....		21 10 0	
	Shot		....		22 10 0	
	Dry White..................		....		27 0 0	
SPELTER	(Cake)		18 5 0	„	18 10 0	
ZINC	(Sheet)		23 10 0	„	24 0 0	
			Per Bottle.			
QUICKSILVER	(in bottles containing 75lbs. each)		....		7 0 0	
			Per Ton.			
REGULUS OF ANTIMONY,	French Star		46 0 0	„	47 0 0	

There has not been much doing in the Metal-market since Friday last.

IRON.—*Scotch Pig* is quiet but steady.

COPPER.—Demand slack, and *Foreign* offering in small quantities on somewhat easier terms. A few sales of *Burra* are reported at £94 10s. 0d. and £95, and a little Chili at £88.

TIN.—*English* was reduced on 21st instant 3s. per cwt. on all descriptions. This movement has caused *Straits* to recede to 113s., at which a fair business has been done.

LEAD.—Good brands of English *Pig* have been in request for immediate shipment at £19 10s. 0d. @£19 17s. 6d. and several hundred tons have been purchased, chiefly on American account.

SPELTER.—Not much doing, a few lots of special brands at Hull being reported at £18 5s. 0d., and £18 7s. 6d.

Copper Ores.

Sampled March 12, and sold at Tabb's Hotel, Redruth, March 27.

Mines.	Tons.	Purchasers.	Price.		
Great Wheal Busy	82	8	£2	1	6
	79	8, 10	2	1	6
	78	2	2	8	6
	63	8	1	16	6
	59	10	2	7	6
	50	7	3	9	6
	47	10	4	1	0
	46	10	3	5	6
	41	2, 14	2	8	6
	28	7, 10	7	2	6
West Caradon	76	8	6	3	0
	75	2, 7	5	4	6
	73	2	12	9	6
	71	3, 10	4	15	6
	67	7	9	8	6
	61	2, 7	7	7	6
	52	2	8	11	6
	46	2	5	5	6
South Caradon	95	4	5	12	0
	82	6	9	3	6
	60	7	8	3	6
	59	2, 6	15	0	6
	45	2, 6	17	1	0
	42	4	5	18	6
	38	14	2	0	6
	35	3	6	2	6
Clifford Amalgamated	68	8	4	7	0
(United Mines)	65	3	4	8	0
	64	11	2	14	0
	63	11	2	13	0
	39	14	3	7	6
	38	11	1	3	0
	37	8	1	12	6
	28	6	3	7	0
Fowey Consols	80	2	7	4	6
	75	2	5	5	0
	73	2	6	16	6
	72	2, 6	6	6	6
East Crinnis & Sou.Par.	100	7	5	9	6
	90	7	5	7	6
East Crinnis & Sou.Par.	50	6	£4	0	0
	45	14	1	17	6
North Treskerby	98	14	3	16	6
	48	8	4	16	0
	47	14	2	3	6
	44	4	5	7	0
	23	4	11	3	0
North Downs	70	6, 7	6	11	6
	62	4	5	17	0
	61	6	8	12	0
	57	6, 8	6	9	0
Tywarnhaile	63	6	3	1	6
	48	6	2	7	6
	44	7	3	1	6
	43	3	5	1	0
	42	14	2	14	6
Craddock Moor	62	7	6	14	6
	49	7	8	0	6
	34	10	5	1	6
	20	6	3	11	0
Wheal Polmear	64	9	3	13	0
	51	6	4	1	0
	25	3	8	17	6
St. Day United	46	8	4	17	6
	42	4	2	15	6
	39	6, 7	2	7	6
South Crinnis	51	5, 7	3	18	6
	44	9	4	4	6
New Treleigh Consols	45	3, 7	4	1	6
	30	5, 7	3	19	6
Wheal Moyle	55	2, 6, 14	0	2	6
	9	12	6	14	6
Duchy and Peru	28	2, 6	2	11	0
	13	2, 6	1	16	0
	10	2, 6	10	14	6
Perran Mines	36	6	4	2	6
Pedn-an-drea	20	10	3	4	6
	5	3	5	12	0
Burra Burra	25	6	4	10	6
Trenouth's Ore	19	6	2	8	0

TOTAL PRODUCE AND VALUE.

Mines	Tons.	Amount.		
Great Wheal Busy	572	£1,670	14	6
West Caradon	521	3,878	17	6
South Caradon	456	3,973	10	0
Clifford Amalgam	402	1,187	16	0
Fowey Consols	300	1,925	7	6
East Crinnis	285	1,315	12	6
North Treskerby	260	1,199	6	6
North Downs	250	1,715	4	0
Tywarnhaile	240	774	12	6
Carddock Moor	165	1,053	14	6
Wheal Polmear	140	£662	0	6
St. Day United	127	433	8	6
South Crinnis	95	386	1	6
New Treleigh Con.	75	302	12	6
Wheal Moyle	64	67	8	0
Duchy and Peru	51	202	1	0
Perran Mines	36	148	10	0
Pedn-an-drea	25	92	10	0
Burra Burra	25	113	2	6
Trenouth's Ore	19	45	12	0

EACH COMPANY'S PURCHASE.

	Company	Tons.	Amount.		
1	Mines Royal	—	——		
2	Vivian and Sons	697¼	£4,886	16	4
3	Freeman and Co.	231	1,228	12	0
4	Grenfell and Sons	306	1,756	14	0
5	Crown Copper Co.	40¼	159	14	3
6	Sims, Willyams & Co.	697 5-6	4,081	7	10
7	Williams, Foster & Co.	721¼	4,320	18	3
8	[illegible]eeyn and Elkington	488	1,910	17	9
9	Bankart and Sons	108	£419	10	0
10	Copper Miners' Co.	294	1,066	2	6
11	Charles Lambert	165	320	9	0
12	Newton, Keates & Co.	9	60	10	6
13	Alkali Co.	—	——		
14	Sweetland & Co.	347 5-6	936	9	7
	Total	4108	£21,148	2	0

[illegible]lers.

[illegible]tinue activ[illegible]

[illegible], 262 tons 6 cwt.

Average Standard £123 14 0

Average Price per ton............ £5 3 0

Average Produce, of Quantity of Fine Copper.

Copper Ores.

Sampled March 19, and sold at Tyack's Hotel, Camborne, April 2.

Mines.	Tons.	Purchasers.	Price.		
Clifford Amalgamated	110	5, 7	£6	3	6
(Wheal Clifford)	105	4	7	0	6
	101	14	4	1	0
	100	5, 7	6	6	6
	91	5, 7	5	17	6
	82	2, 3	4	16	6
	62	4	6	10	0
	61	8	5	7	0
	46	6	8	10	6
	45	8	4	8	0
	34	16	3	8	6
	30	2	4	5	0
(Consols)	63	2	5	17	6
West Seaton	76	4	7	14	0
	75	2, 3	7	14	0
	67	14	2	10	0
	59	4	6	7	0
	57	4	4	13	0
	56	10	5	1	6
	52	10	4	9	0
	51	5, 7	8	1	6
	38	3	6	14	6
Tincroft	108	9	0	10	6
	70	2	2	18	6
	65	8	4	19	6
	49	2, 7	4	13	6
	48	10	4	11	0
	40	11	2	18	0
	33	4	6	12	0
	19	14	1	14	6
East Pool	64	3	4	10	0
	61	11	3	15	6
	45	2, 6, 9	0	5	6
	41	8	4	12	6
	33	10	4	6	6
	32	11	2	13	6
	26	11	2	13	6
	18	11	1	9	0
Wheal Seton	27	8	4	3	6
(Pendarves)	83	10	1	1	6
Whl. Seton (Pendarves)	62	2	£4	15	6
	44	2, 7	4	17	6
	43	2, 7	7	13	6
	30	2, 7, 8	14	0	6
	22	3	2	14	0
Wheal Basset	73	6	7	14	6
	61	7	5	14	6
	57	2, 9	4	18	6
	42	2, 7	7	16	6
	23	2	1	7	6
Condurrow	93	6	1	14	6
	78	5, 7	5	18	0
	74	11	2	4	0
	6	8	11	11	0
South Frances	59	2	4	19	0
	42	5, 7	6	14	6
	41	3	6	1	6
	39	7	5	4	6
	21	8	8	3	0
	5	7	4	15	0
South Tolgus	75	5, 7	4	6	0
	56	5, 7	8	14	6
Camborne Vean.........	62	8	5	1	0
	60	14	3	5	0
East Basset	57	2, 6	3	19	6
	45	9	3	14	0
	18	2, 6	6	13	0
Stray Park	53	5, 7	3	3	0
	21	5, 7	7	14	6
Dolcoath	48	14	3	19	6
South Crofty	22	8, 11	1	15	0
	21	7	7	4	6
West Tolgus	36	2	3	14	6
South Basset	30	8	2	6	0
Wheal Uny	19	8	3	8	6
	11	2	9	8	0
Carn Camborne	30	8, 14	2	16	6
West Condurrow	4	2	5	15	0
Halse's Ore	1	4	4	5	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Clifford Amalgam	930	£5,322	5	6
West Seton	531	3,152	17	6
Tincroft	432	1,398	17	6
East Pool............................	320	1,044	5	0
Wheal Seton	311	1,522	13	6
Wheal Basset	256	1,554	3	0
Condurrow	251	852	14	6
South Frances......................	207	1,222	5	0
South Tolgus	131	811	2	0
Camborne Vean..................	122	508	2	0
East Basset	120	£512	15	6
Stray Park	74	329	3	6
Dolcoath	48	190	16	0
South Crofty	43	190	4	6
West Tolgus	36	134	2	0
South Basset	30	69	0	0
Wheal Uny	30	168	9	6
Carn Camborne....................	30	84	15	0
West Condurrow	4	23	0	0
Halse's Ore	1	4	5	0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.		
1	Mines Royal............... ..	—	——		
2	Vivian and Sons......	616½	£3,078	3	6
3	Freeman and Co.	243½	1,338	12	0
4	Grenfell and Sons	393	2,587	11	6
5	Crown Copper Co..........	338½	2,070	11	3
6	Sims, Willyams & Co. ...	274½	1,434	0	3
7	Williams, Foster & Co....	563½	3,490	8	3
8	Mason and Elkington ...	403	1,899	6	6
9	Bankart and Sons	196½	£367	13	9
10	Copper Miners' Co.	306	1,082	8	0
11	Charles Lambert	262	709	11	6
12	Newton, Keats & Co. ...	—	——		
13	Alkali Co.	—	——		
14	Sweetland and Co.	310	1,037	10	0
	Total	3907	£19,095	16	6

Average Produce, 6.
Quantity of Fine Copper, 234 tons 10 cwts.

Average Standard £127 5 0
Average price per ton 4 17 6

Copper Ores.

Sampled March 26, and sold at Tabb's Hotel, Redruth, April 10.

Mines.	Tons.	Purchasers.	Price.	Mines.	Tons.	Purchasers.	Price.
West Basset	67	7	£5 13 0	Prosper United	107	2	£6 7 6
	63	10	4 11 0		23	2	5 14 0
	60	8	13 11 0	Pendeen Consols	64	6	3 14 0
	54	4, 8	4 10 0		32	6	2 1 0
	53	11	5 6 0		14	6	3 17 6
	52	11	4 6 6		8	2	17 5 6
	43	4	8 0 0	West Alfred Consols	45	2	1 2 6
	30	6	10 17 6		27	8	3 16 6
	27	8	5 3 0		23	2	1 8 0
	22	8	6 9 0		12	11	1 1 0
Carn Brea	127	2	0 2 0		10	8	1 0 6
	67	7	6 19 0	Rosewarne United	58	7	9 17 6
	58	3	4 12 0		40	4	4 19 6
	41	2	3 16 6		5	3	10 13 0
	40	2	4 7 6	Copper Hill	59	4	3 4 6
	38	8	2 17 6		34	3, 6	9 15 6
	35	14	2 6 6		8	6	27 3 0
Par Consols	78	2, 3	10 13 6	Treloweth	52	6	6 8 6
	76	7	7 14 0		26	2, 6	13 7 6
	70	4	6 12 6	Wheal Buller	44	3	4 5 0
	30	9	4 5 0		29	3	9 2 6
Great South Tolgus	60	10	6 11 0	Wheal Anna	41	2, 6	1 13 6
	49	7	10 16 6		22	10	4 9 0
	47	10	7 8 6	Wheal Unity Consols	26	8	3 13 0
	30	2, 3	9 17 6	Rosewarne Consols	21	2, 8	10 8 6
Great Wheal Alfred	50	8	4 6 6		5	4	32 8 6
	44	8	2 12 0	Boiling Well	25	2, 14	1 16 6
	42	7	3 18 6	Gurlyn	25	2, 8	8 18 6
	39	11	2 11 0	South Dolcoath	17	4, 8	11 12 0
Wheal Charlotte	61	7	7 18 0	Great Wheal Fortune	10	8	7 0 0
	56	7	6 13 6	Camborne Consols	8	2, 4	9 0 6
	25	6, 10, 11	2 4 6	North Great Work	4	14	3 11 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
West Basset	471	£3,178 4 0	Treloweth	78	£681 17 0
Carn Brea	406	1,267 12 0	Wheal Buller	73	451 12 6
Par Consols	254	2,009 2 0	Wheal Anna	63	166 11 6
Great South Tolgus	186	1,568 13 0	Wheal Unity	26	94 18 0
Great Wheal Alfred	175	594 19 0	Rosewarne Consols	26	381 1 0
Wheal Charlotte	142	855 6 6	Boiling Well	25	45 12 6
Prosper United	130	813 4 6	Gurlyn	25	223 2 6
Pendeen Consols	118	494 17 0	South Dolcoath	17	197 4 0
West Alfred Consols	117	208 19 0	Great Wheal Fortune	10	70 0 0
Rosewarne United	103	825 0 0	Camborne Consols	8	72 4 0
Copper Hill	101	739 16 6	North Great Work	4	14 6 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Mines Royal	—	—	9 Bankart and Sons	30	£127 10 0
2 Vivian and Sons	541	£2,431 7 6	10 Cooper Miners' Co.	200½	1,145 1 4
3 Freeman and Co.	207	1,502 6 0	11 Charles Lambert	164½	686 7 10
4 Grenfell and Sons	256½	1,615 7 0	12 Newton, Keates & Co.	—	—
5 Crown Copper Co.	—	—	13 Alkali Co.	—	—
6 Sims, Willyams, & Co.	258 17½	1,627 2 7	14 Sweetland and Co.	51½	118 9 9
7 Williams, Foster & Co.	476	3,497 2 6			
8 Mason and Elkington	372½	2,253 6 0	Total	2558	£14,954 2 6

Average Produce, 7.
Quantity of Fine Copper, 179 tons 8 cwt.

Average standard £122 12 0
Average Price per ton 5 17 0

Copper Ores.

Sampled April 2, and sold at the Royal Hotel, Truro, April 17.

Mines.	Tons.	Purchasers.	Price.	Mines.	Tons.	Purchasers.	Price.
Devon Great Consols...	134	6	£4 2 0	Great Wheal Martha ...	46	2, 6	£5 9 6
	133	6	4 16 0	Crelake...	118	8	3 5 6
	130	9	4 6 6		107	7	4 9 6
	122	10	4 13 6		44	10	6 17 6
	105	8	3 18 6		38	10	3 0 0
	101	11	3 16 6		33	8	3 3 0
	98	12	9 1 0	Wheal Edward	102	3	2 1 0
	96	11	3 15 0		101	3	4 1 0
	95	2, 11	2 15 0		40	14	3 12 6
	83	2, 3	10 3 6		34	14	3 7 6
	76	14	3 11 0		25	3	10 18 0
	74	2	8 3 0	North Wheal Robert...	74	6	8 19 0
	73	7	4 4 6		66	10	1 9 6
	71	2	4 3 6		38	6	22 3 6
	67	7	7 14 6		36	10	4 6 6
	66	2	4 3 0	Bedford United	112	5, 7	4 17 6
	63	2	9 10 6		98	5, 7	4 15 6
	62	6	2 15 0	Wheal Emma	58	9	4 17 6
	42	2, 3	11 6 6		46	5, 7	9 10 6
East Caradon	107	14	6 4 0		37	2	2 1 6
	95	8	5 1 0	Sortridge Consols	82	6, 8	8 9 0
	86	14	5 0 0		56	10	4 14 0
	71	2, 6	9 3 6	Wheal Arthur	82	8	2 15 0
	46	2, 6	6 8 0		50	6, 8	3 46 6
	25	2, 6	14 7 0	Wheal Friendship	78	5, 7	7 17 6
Marke Valley	110	9	5 0 6		48	5, 7	10 9 6
	100	5, 7	3 18 6	Okel Tor	60	8, 11	2 5 0
	75	2	4 13 0		40	8, 11	2 14 6
	59	9	5 16 6	Devon and Cornwall...	69	8, 11	1 16 0
	56	2, 9	3 5 0		26	6, 8	7 8 0
Phœnix Mines	85	14	2 17 6	Molland	57	5, 7	5 0 6
	84	4	3 3 6	Wheal Crebor	44	8, 10	3 19 6
	71	4	3 19 6	Brookwood	42	3, 6	4 7 0
	63	4	8 18 6		2	2	20 15 6
	57	4	3 15 0	Trehill	29	2, 6	1 18 6
Great Wheal Martha...	100	2, 6	1 18 0	Hawkmoor	27	5, 7	3 14 6
	70	2, 6	3 5 0	Redmoor	25	2, 6	4 2 6
	69	2, 6	1 16 6	Devon and Courtenay.	22	6	2 4 0
	60	2, 6	2 0 0	Kitt Hill	15	2, 6	0 7 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
Devon Great Con...............	1691	£8,986 19 6	Wheal Friendship	126	£1,117 1 0
East Caradon	430	2,877 14 6	Okel Tor....	100	244 0 0
Marke Valley	400	1,819 13 6	Devon and Cornwall	95	316 12 0
Phœnix Mines	360	1,569 6 6	Molland	57	286 8 6
Great Wheal Martha	344	911 11 0	Wheal Crebor	44	174 18 0
Crelake	340	1,385 14 6	Brookwood	44	224 5 0
Wheal Edward	302	1,150 8 0	Trehill	29	55 16 6
North Wheal Robert	214	1,758 0 0	Hawkmoor	27	100 11 6
Bedford United.................	210	1,013 19 0	Redmoor	25	103 2 6
Wheal Emma	141	797 13 6	Devon and Courtenay.........	22	48 8 0
Sortridge Consols	138	956 2 0	Kitt Hill............................	15	5 12 6
Wheal Arthur	132	416 15 0			

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Mines Royal Co................	—	——	9 Bankart and Sons............	385	£1,832 8 6
2 Vivian and Sons................	803	£4,312 12 9	10 Copper Miners' Co.	384	1,590 11 0
3 Freeman and Co.	311	1,642 1 9	11 Charles Lambert	329	1,061 1 0
4 Grenfell and Sons	275	1,324 19 0	12 Newton, Keates & Co. ...	98	886 18 0
5 Crown Copper Co.............	283	1,674 6 6	13 Alkali Co.	—	——
6 Sims, Willyams & Co.	840	4,731 12 6	14 Sweetland and Co.	428	1,867 6 6
7 Williams, Foster & Co.......	530	2,979 3 0			
8 Mason and Elkington	618	2,417 12 0	Total	5286	£26,320 12 6

Average Produce, 6¼
Quantity of Fine Copper, 328 tons 10 cwt.

Average Standard £124 7 0
Average Price per ton 4 19 6

Copper Ores.

Sampled March 12, and sold at Swansea, April 1.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	92	11	16	£9 9 6	Great Barrier	98	12⅝	7	£11 0 0
	86	11	1, 14	9 3 6	Lochwinnoch	78	2⅜	6	1 18 0
	82	11½	1	9 2 6		7	3⅞	16	3 0 6
	70	11	10	9 6 6		4	9¾	16	8 10 6
Knockmahon	102	5⅝	10	4 8 0	Springbok	55	27¾	5	25 1 0
	92	9⅞	6	8 14 0		7	36⅛	5	33 4 0
	89	10⅞	2, 7	9 8 0					

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount.
Cobre	330	£3,061 15 0	Lochwinnoch	89	£203 9 6
Knockmahon	283	2,085 16 0	Springbok	62	1,610 3 0
Great Barrier	98	1,078 0 0			

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		Tons.	Amount.
1 Copper Miners' Co.	125	£1,142 15 6	10 Mason and Elkington	172	£1,101 11 0
2 Freeman & Co.	44½	418 6 0	11 Bankart and Sons	—	——
3 Grenfell and Sons	—	——	12 Charles Lambert	—	——
4 Crown Copper Co.	—	——	13 Ravenhead Copper Co.	—	——
5 Sims, Willyams & Co.	62	1,610 3 0	14 Sweetland, Tuttle & Co.	43	394 10 6
6 Vivian and Sons	170	948 12 0	15 Bold Copper Co.	—	——
7 Williams, Foster & Co.	142½	1,496 6 0	16 Jennings and Co.	103	926 19 6
8 Mines Royal	—	——			
9 British & Foreign Copper Co.	—	——	Total	862	£8,039 3 6

Copper Ores.

Sampled March 26, and sold at Swansea April 15.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	100	10⅛	9	£8 14 0	Cuba	62	21⅝	6	£17 18 0
	99	10¼	1	8 14 0	(Precipitate)	5	66⅝	9, 11	54 12 6
	98	10½	11	8 14 6	Berehaven	110	10⅛	10	9 7 6
	97	10⅝	6	8 11 0		92	10¾	11	9 5 6
	96	10¼	1	8 10 6		82	10¾	1	9 4 6
	83	10⅝	9	8 11 6		68	10¾	3	9 7 0
	63	21⅞	7	18 7 0		120	10⅝	6, 7	9 4 0
	62	20⅞	2	18 3 0		113	10⅝	2, 6	9 4 0
	12	58⅞	9	49 1 6	Laxey	136	6⅝	3	5 15 0
Cuba	100	13⅜	7	11 0 6	Knockmahon	95	11⅜	2, 7	10 6 6
	95	13	6	10 14 0	Australian Reg.	11	50⅛	2	46 5 0
	90	13⅞	6, 7	10 14 0	Holyford	4	9⅝	7	8 6 0
	80	13¾	3	11 1 0	Spanish	2	19½	6	16 10 0
(Precipitate)	7	66⅝	16	57 2 6		1	24⅛	6	21 0 0
	66	21⅝	3	17 18 0		1	10⅛	6	9 0 0
	64	21⅝	6, 7	17 19 0	Slag	1	4	1	2 0 6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		Tons.	Amount
Cobre	710	£7,816 1 6	Australian Regulus	11	£508 15 0
Cuba	569	8,079 0 0	Holyford	4	33 4 0
Berehaven	575	5,420 8 0	Spanish	4	63 0 0
Laxey	136	782 0 0	Slag	1	2 0 6
Knockmahon	95	980 17 6			

EACH COMPANY'S PURCHASE.

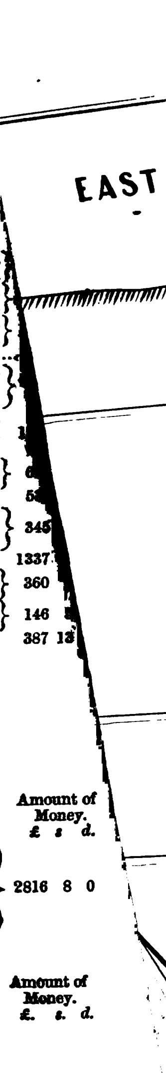
	Tons.	Amount.		Tons.	Amount
1 Copper Miners' Co.	278	£2,438 3 6	10 Mason and Elkington	110	£1,031 5 0
2 Freeman and Co.	177	2,644 5 9	11 Bankart and Sons	192½	1,844 18 3
3 P. Grenfell and Sons	350	3,483 4 0	12 Charles Lambert	—	——
4 Crown Copper Co.	—	——	13 Ravenhead Copper Co.	—	——
5 Sims, Willyams & Co.	—	——	14 Sweetland and Co.	—	——
6 Vivian and Sons	451½	5,146 7 0	15 Bold Copper Co.	—	——
7 Williams, Foster & Co.	351½	4,390 1 9	16 Jennings and Co.	7	399 17 6
8 Mines Royal	—	——			
9 British & For. Copper Co.	197½	2,307 3 9	Total	2115	£23,685 6 6

Lead Ore Sales.

Dates.	Mines.	Tons.	Price per Ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Mar. 21.	Dyliffe	70	12	3	6	A. Eyton	852	5	0
	Aberdovey	34	11	7	0	Newton, Keates & Co.	385	18	0
	Dyfngwm	20	11	10	0	ditto	230	0	0
	Laxey	100	17	3	0	Sims, Willyams & Co,	1715	0	0
„ 26.	Wheal Mary Ann	62	25	3	6	T. Somers	2029	17	0
	„	40	11	14	6	Treffry's Trustees			
	East Jane	14	12	11	6	Sims, Willyams & Co.	176	1	0
„ 27.	Westminster	50	11	8	6	Walker, Parker & Co.	571	5	0
	Mount Pleasant	35	11	12	0	A. Eyton	544	5	0
	„	10	13	16	6	Walker, Parker & Co.			
	Hendre Ucha	22	11	14	0	ditto	257	8	0
	Pant-y-Buarth	10	11	1	6	ditto	110	15	0
	Trelogan	5	11	8	6	A. Eyton	57	2	6
	Garreg	6	11	8	0	ditto	68	8	0
	Dyliffe	60	12	0	6	ditto	721	10	0
	Nant-y-Iago	14	10	10	6	Walker, Parker & Co.	147	7	0
	Roman Gravels	30	11	10	6	ditto	345	15	0
	Pool Park	15	12	3	6	ditto	182	12	6
	Lower Park	5	11	6	6	Newton, Keates & Co.	56	12	6
„ 28.	Ex *St. Elmo* (at Liverp.)	50	10	12	6	Locke, Blackett & Co.	531	5	0
„ 31.	East Logylas	70	11	17	0	Walker, Parker & Co.	829	10	0
	Glogfach	60	14	3	0	Sims, Willyams & Co.	849	0	0
	Cwymystwith	100	11	15	0	ditto	1175	0	0
	Goginan	37	15	5	0	ditto	675	9	0
	„	8	13	18	0	ditto			
April 1.	Dyfngwm	14½	11	10	6	Walker, Parker & Co.	334	4	6
	„	14½	11	10	6	A. Courage and Co.			
	Rhoswydol	10	11	5	0	A. Eyton	112	10	0
	Minera	110	11	16	6	Newton, Keates & Co.	7324	14	0
	„	105	11	16	6	Locke, Blackett & Co.			
	„	100	12	0	0	Newton, Keates & Co.			
	„	100	11	16	6	ditto			
	„	100	12	13	0	Jones, McNicoll & Co.			
	„	75	12	13	6	ditto			
	„	12	10	10	0	Locke, Blackett & Co.			
	„	4	13	8	6	Jones, McNicoll & Co.			
„ 2.	Isle of Man Mining Co.	100	22	10	6	Treffry's Trustees	2252	10	0
„ 4.	Dyliffe	30	12	2	6	Adam Eyton	363	15	0
„ 5.	Llanfyrnach	30	11	15	0	Panther Co.	352	10	0
„ 7.	Carmarthen United	26	12	0	6	Sims, Willyams & Co.	312	13	0
„ 9.	North Minera	20	11	10	6	Cookson and Co.	230	10	0
„ 10.	Talargoch (Maesyrerwddu)	66	12	7	6	Walker, Parker & Co.	1080	2	6
	„ (Coetia Llys)	21½	12	5	0	ditto			
	Deep Level	12	11	5	6	ditto	135	1	6
	Brynford Hall	11½	11	7	6	ditto	130	16	3
	Herward United	9½	10	4	6	ditto	97	2	9
	Rhosesmor	120	12	2	6	Adam Eyton	1455	0	0
	Orsedd	15	11	16	6	Walker, Parker & Co.	177	7	6
	Parrys	30	11	18	6	ditto	354	15	0
	West Merllyn	4	12	0	6	ditto	48	2	0
	Kilmory	7	11	5	0	ditto	78	15	0
	North Henblas	5	10	10	0	ditto	52	10	0
	Dyliffe	66	11	11	0	ditto	762	6	0
	Llanerchyraur	45	12	10	0	Newton, Keates & Co.	562	10	0
	Llangynog	10	11	0	6	ditto	220	10	0
	„	10	11	0	6	Walker, Parker & Co.			
	Bryn Gwiog	36	11	13	6	ditto	420	6	0
	Long Rake	15	11	6	6	ditto	169	17	6
„ 11.	Cargoll	100	12	7	6	R. Michell and Son	1287	10	0
„ 14.	Dyliffe	40	11	11	0	Adam Eyton	815	16	0
	„	30½	11	12	0	A. Courage and Co.			
	Frongoch	170	11	0	6	Walker, Parker & Co.	1874	5	0
	East Darren	60	14	0	6	ditto	841	10	0
	Cwm Erfin	25	13	15	6	ditto	776	12	6
	„	30	14	7	6	ditto			
„ 15.	Clara United	20	11	8	0	Sims, Willyams & Co.	228	0	0
„ 19.	Chiverton	64	16	0	0	R. Michell and Son	1339	14	6
	„	36	8	16	6	ditto			

Black Tin Sales.

Date.	Mines.	Tons.	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.	
Mar. 29.	St. Day United	15	13	0	18	55	0	0	Mellanear	
April 2.	,,	18	0	1	13	55	0	0	Trethellan	
Mar. 29.	Tincroft	20	7	0	7	63	15	0	Bolitho and Sons	
April 2.	,,	6	13	3	27	63	15	0	Bissoe Co.	
Mar. 29.	Drake Walls	8	0	0	0	70	0	0	R. Michell and Co.	
	,,	15	10	0	0	67	5	0	ditto	
April 5.	Gurlyn	6	3	0	25	64	15	0	Chyandour	
,, 6.	Ashburton United	4	7	0	19	68	10	0	Bissoe Co.	
	,,	4	6	2	19	68	1	6	Daubuz and Co.	
	,,	4	5	2	10	68	2	0	Calenick Co.	
,, 9.	Redmoor	3	0	0	0	64	7	6	Bissoe Co.	
,, 11.	Gt. Wh. Vor	23	5	3	26	—			—	1
,, 12.	Pedn-an-drea	11	9	1	4	—			Bissoe Co.	
	South Carn Brea	5	8	0	21	62	7	6	Carvedras	6
	,,	5	5	3	15	61	15	0	Chyandour	
,, 15.	Kitty (St. Agnes)	8	16	0	22	60	7	6	Harvey and Co.	5
	Brea Consols	4	2	0	18	70	15	0	R. Michell and Co.	
	,,	0	15	1	21	60	0	0	ditto	345
	,,	0	4	0	9	42	0	0	ditto	
,, 17.	Wendron Cons.	21	6	0	25	—			Carvedras	1337
,, 19.	Penhalls	5	17	0	6	—			Enthoven and Son	360
	,,	0	1	1	0	—			Harvey and Co.	
	Wheal Union	1	14	3	0	65	0	0	Chyandour	146
	,,	0	10	0	11	66	0	0	ditto	
	Wheal Uny	6	5	0	6	62	0	0	ditto	387 13



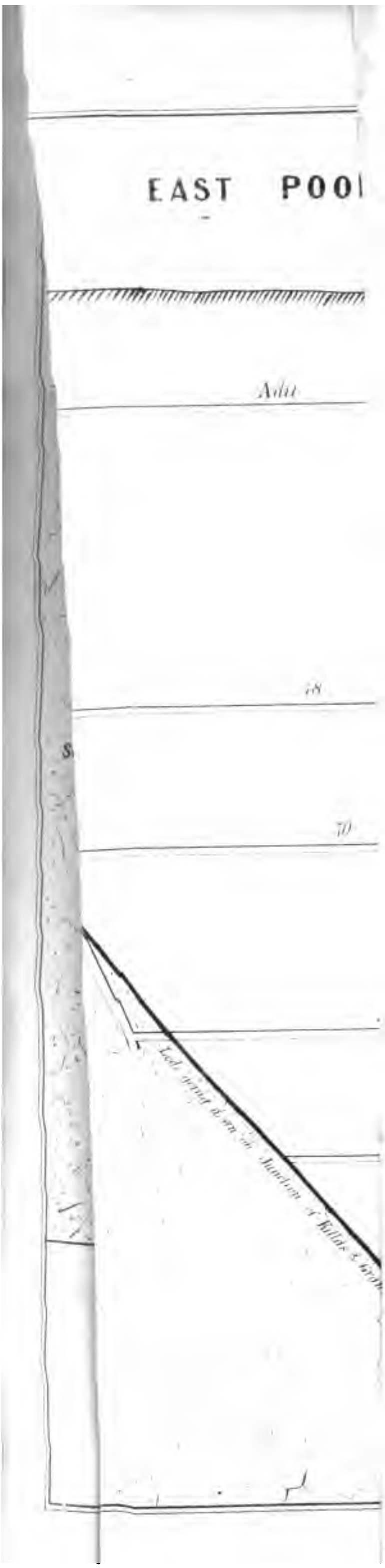
Sundry Copper Ore Sales.

Date.	Mines.	Tons.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
April 17. Lot 1	Parys Mines	100	6	1	6	Newton, Keates & Co.	2816	8	0
2	,,	98	6	2	0	ditto			
3	,,	95	6	4	6	ditto			
4	,,	87	6	3	6	ditto			
5	,,	105	2	9	0	Charles Lambert			
6	,,	85	2	13	0	ditto			

Sold by Mr. PITCAIRN CAMPBELL.

Date.	Mines.	Tons.	c.	Price per ton. £.	s.	d.	Purchasers.	Amount of Money. £.	s.	d.
April 17. Lot 1	,,	7	0	19	17	6	Vivian and Sons	550	18	1
2	,,	0	17	26	14	0	ditto			
3	,,	1	0	22	11	6	ditto			
4	,,	0	4	64	3	6	ditto			
5	,,	5	10	5	14	0	ditto			
6	,,	49	0	3	0	0	Charles Lambert			
7	,,	15	0	1	13	0	ditto			
8	,,	20	0	1	13	6	J. Keys and Son			
9	,,	11	0	10	16	6	Newton, Keates & Co.			

Date.	Mines.	Tons.	c.	q.	lbs.	Price per ton. £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
Mar. 6.	Alderly Edge (precipitate)	17	0	3	0	54	12	3	Sims, Willyams & Co.	2729	19	
,, 18.	,,	13	17	2	0	55	5	0	—			
Apr. 3.	,,	17	8	1	0	59	7	10	—			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MINING AND SMELTING MAGAZINE.

JUNE, 1862.

Gold Mining at Clogau, North Wales.

BY WARINGTON SMYTH, M.A., F.R.S., SEC.G.S.,
Chief Inspector of Crown Mines.

> "Put forth thy hand, reach at the glorious gold!"
> Pt. II, HENRY VI, Act 1.

THE bare existence of gold in various parts of our islands has been the subject of remark from the time of the invasion of the Romans. In most of the places which acquired a notoriety for its occurrence it was found only as spangles or dust in the alluvium of stream works,—as at Pentuan, &c., in Cornwall; Croghan Kinshela, in Ireland; Lead-hills, in Scotland. In a few instances it had graced part of a solid vein—as near South Molton: in others it was, in all likelihood, merely represented by those frequent deceivers of the ignorant, pyrites and mica.

But during the last twenty years, and this is going back some time before men's eyes were opened by the discoveries in California, a remarkable character has attached itself to a portion of North Wales as a gold-containing district; and even whilst it remained doubtful whether any commercial importance could be ascribed to its presence, the facts were not the less interesting to the mineralogist.

Who the Cadmus was that first, on the hills of Merionethshire, exclaimed with Shakespeare's Timon—

> "What is here?
> "Gold? yellow, glittering, precious gold?"

appears to be already uncertain,—precedence being claimed by several persons. But the first account in print was, I believe, the paper of Mr. Arthur Dean, communicated to the British Association in 1844, in which, not satisfied with stating the few meagre facts known at the time, the author generalized fearlessly, and evolved a complete net-work of lodes, as Germanic writers say, out of the depths of his internal consciousness.

Soon after this, in 1846, I had the opportunity of minutely examining some of the more notable lodes near Dolgelly, in the district which had most attracted attention. The Cwm-heisian mine, originally opened to work some lead veins, had just been sold as a "gold mine" for 14,000*l.*, neither buyer nor seller having made the slightest approximation to an estimate of the length, breadth, or depth of the auriferous ground, or of its fair average yield.* The assays and experiments made by Mr. Clement, who was called in to act as metallurgist, showed that the specimens contained a proportion of gold which would be considered highly profitable in the old gold mining districts of Salzburg, of Hungary, and of America. Great expense was incurred by Mr. Bruin, the new owner, not in working the ground, or in erecting apparatus under the advice of men who were practised in gold mining, but in following out the contrivances of ingenious schemers; and the result was a very early suspension of all operations.

The historical sketch of what has occurred since 1846, in connexion with the gold in the Dolgelly district, might be extended to great length, and not without profit to intending speculators; but I have only glanced at it for the purpose of showing the early date of the original discovery, and the unwise course of action of the adventurers, which has been repeated over and over again by others, down to the present moment. Let me only state, briefly, that after the astounding harvests of gold in California and Australia, and the stirring up of the Exhibition, in 1851, a quicker pulse began to beat in the veins of lessees and explorers and proprietors connected with North Wales, which in 1854 and 1855 broke into a violent yellow fever, and swept over the region between Cader Idris and Snowdon, a "rush" of sharebrokers, miners, tradesmen, swindlers, and inventors, who kept the country in a not unpleasant excitement for about a couple of years. The track of the inundation may still be traced by the curious in the shape of deserted water-wheels, cast-iron balls —massive beyond the dreams of Armstrong or of Whitworth,— unpaid inn bills, and ruinous buildings. Quicker than it arose, the whole affair collapsed; some might call it a bubble, but that I cannot do, seeing that during this time gold was discovered, generally visible too, in a number of different veins, and that the true value of it was never fairly tested. Many thousands of pounds were "expended." In what? Certainly not in miner's work, for there were only two or three instances in which the rock was attacked, but rather in surface erections,—in contrivances patented by people who had never seen a well-provided gold mine, and in transactions for the passage of money from one hand to another. And whilst several hundreds (perhaps one might say thousands) of pounds worth of gold were carried off as specimens, or ostensibly for assays and trials on the grand scale, respectable people in the very town of Dolgelly doubted the existence of the gold *in toto*,—and Her Majesty, the proprietress of the royal metal, was simply robbed of every tittle of her dues.

A period of bankruptcy and destruction of character followed, in

* The seller of the mine was the late Mr. James Harvey, who deserves to be mentioned as an enthusiastic amateur of mines, and especially as a firm believer in the ultimate success of gold mining around Dolgelly.

which poor Nature, in the name of the Welsh gold districts, suffered; for much of that obloquy which should have been entirely kept for the scheming intruders in the land of the Cymry was allowed to attach to the innocent district.

During the last two years and a-half a fresh series of events has occurred, consisting mainly of the farther discovery and successful treatment of auriferous vein-stuff at Clogau. The excitement on the subject, long repressed by the recollection of former mishaps, is now culminating. If certain people are not more honest than they or their precursors were eight years ago, it is time, at least, that others should be more prudent.

Many of my readers are, doubtless, acquainted with the road from Dolgelly to Barmouth—one of the most beautiful scenes in Great Britain. Half-way between the two places, an impetuous stream, descending from the high range of Llawllech, pours its waters over a rocky bed to join the Mawddach, below Pontddu. On either side of this bright and leaping river there rises a mountain, in which copper veins have, for many years, been worked on the west, the Vigra, and on the right the Clogau. The minerals on both sides belong to the Crown, but had been leased some years ago; and soon after the period of monetary break down, to which I have above referred, it was very difficult, what with mortgages, and bankruptcies, and sales, to comprehend who were the responsible parties. A vein in which gold had been found in 1854 was left untouched, but workings were carried on in the copper lodes after a fashion so barbarous as to excite the astonishment of every miner who inspected them; and as might be expected, neither profit nor proof of the farther existence of ore followed.

By the end of 1859 the ownership of the mine was brought into clearer light; a limited liability company was formed, and a couple of men were set to drive on the gold vein, named St. David's lode, which, in the "end" at that time, offered no appearance of gold, the level having passed through that part which had yielded gold before, and got into dead ground.

This lode lies about a quarter of a mile further north than the Clogau copper lode, coursing in the same manner about E.N.E. by N., and intersecting dark schistose rocks of the lower silurian formation, with which are associated both interstratified and intrusive or dike-formed greenstones. On the north, at the distance of a few hundred feet, the massive greenish grits of the Cambrian system pass out from under the highly-inclined beds of the lower silurian or lingula flags, but from the intense cleavage of the masses it is often difficult to recognise this arrangement of the strata.

The vein itself, where well-developed, is from 2½ to 9 ft. in width, between distinct walls, especially on the south, underlying commonly to the north, but on the whole nearly perpendicular. It is composed of quartz and calcareous spar, the latter sometimes forming a body of several feet in width; and when the calcite puts on the appearance of a finely granular and friable marble, it frequently contains gold; when, on the contrary, it is large and coarsely foliated, it appears to be entirely wanting in the precious metal. Spots of iron and copper pyrites are not unfrequent, and hence the lode was originally opened

upon for copper; fragments of the more or less talcose schist of the walls are occasionally included; and sometimes in one part, sometimes in another, the delicate pale yellow points and spangles of gold may be seen disseminated in the calc spar or quartz, often accompanied by bright white crystalline scales of the mineral of tellurium, sulphur, and bismuth, called tetradymito.* The laminæ of division of the rocks which form the country on either side of the lode strike a few degrees more north of east, so that they are intersected somewhat obliquely by the walls, and it requires watchfulness on the part of the manager to prevent, when the vein is obscure, the men's turning the level off from the lode.

Another noticeable feature is the frequent occurrence of planes of division nearly horizontal, crossing the lode from one wall to the other. These, in some veins, we may see to be filled with zinc blende or calc spar, as some of the newer formed minerals, but at Clogau I have been unable to observe that the gold has any connexion at all with these comparatively late fissures.

I wish I could add that the above-mentioned limits give the constant breadth of the lode; but, constant to the habits of the repositories of the precious metal, St. David's exhibits a capricious variation within short distances in excess of the well-known variability of other metalliferous veins. There are places, in fact, where a mere thread of spar, or even a slight division only, very easily overlooked, constitutes the only vestige of what, a fathom or two back, was a body of 9 feet wide. Let no one, therefore, think to obtain success, or even to make an estimate of the value of a sett, by pricking a few feet here and there, according to the method which has been so commonly adopted in Welsh explorations. Nothing but a steady and systematic opening of ground by driving and sinking can give any idea of the worth of a gold vein: one portion, where the gold is visible, will be exceedingly rich; another, where, perhaps, it can no longer be seen, will pay; another will not contain a trace; and further, perhaps, the lode itself is for some distance entirely nipped to nothing. I must, however, do justice to a good local miner in John Parry, who for many years has managed the mine, and to whom is mainly due the successful treatment of the ore, by remarking that little as his successive principals seem to have understood some of the plainest principles of mining, he has always felt the hardship of being ordered to rob his copper lodes like a caffre, or to stay his hand when he ought to be opening ground.

The level, or adit, driven on St. David's lode, is very near the top of the moutain, and penetrates now nearly fifty fathoms, at a moderate depth, beneath the showy and instructive out-going or crop of the lode, projecting several feet above the grass-covered knoll. A little further east than the shallow adit has reached, the lode turns off a

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* The mineral occurs in thin crystalline plates and scales of brilliant metallic lustre and silver whiteness. Hardness, 1·5 to 2. In the matrass it gives a grey sublimate; in the glass tube, a whitish one; on charcoal, a yellowish incrustation, with white border, which an application of the reducing flame chases away with a blueish flame. Melts easily into a bright metallic bead, which in cooling coats over dark, and which is very brittle. I have observed no smell of selenium with it, which is usually noticeable in the Hungarian tetradymite.

little abruptly a few points further north, and a dike of greenstone crossing obliquely seems to give rise to some confusion before we arrive at the boundary of the estate of Garth Gell.

Some six and twenty years ago, when this lode was expected to turn out a copper mine, a cross-cut was put into the lode from the north, 12½ fathoms deep, which, on cutting a great coarse lode, 8 or 9 feet big, of white quartz, with spots of calc spar, was given up in despair. This has now furnished a second point of attack, and a winze has been put through between the two levels, and the chief result is, that although a rich bunch has not yet been cut below, gold has been proved to exist all through.*

In 1860, it became evident that the chiefly important part of the vein was the comparatively small bulk of it which contained visible gold; hence arises a great convenience, both in breaking it securely underground and in manipulating it at the surface. The apparatus at command of John Parry were a "Britten's" machine and a big "Berdan," obtained in the earlier years of goldy expectations. The former is a large mortar, with a somewhat conical pestle worked round and round against the cast-iron sides of the mortar by machinery; the second is the gigantic basin and balls, whose introduction by an astute Yankee is yet felt by the pocket of many a duped Britisher. But the quantities to be dealt with being moderate, the question of more efficient machines for stamping or grinding was postponed, and trials were made principally with the smaller, in suitably triturating and amalgamating at the same time; and when it was proved that blocks of 150 lbs. weight would yield 8 or 10 ozs. of gold, and that two men stoping the vein could more than keep the machine going, the day of the doubters seemed to be closing in. It has proved, that when the tetradymite is present (as it often is with some of the best parts of the lode) it is desirable to calcine the stone before attempting to amalgamate; the remainder, however, is only spalled down to a convenient size, and fed at once raw into the machines. The frequency of addition of water and of "stuff" to the mercury in the basins, as well as the time for clearing out, varies according to the circumstances, which Parry appears now to have mastered. Slowly and steadily, and with never more than four men stoping in the vein (four others driving in the end) the quantity of gold returned has been increased; and in face of the somewhat faint praise, and wishy-washy admissions of value, which have appeared in certain papers on the subject of this, our first successful British gold mine, the following figures show, not only the telling amount realized by the continuous working, but also the large proportion of it which is obtained by the use of a small and inexpensive apparatus.

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* Whilst these pages were in the press, a discovery of good visible gold in the deep level was announced.

RESULTS OF WORKING FOR THE YEAR 1861.

	Quantity.			Yield of Gold.		
	Tons.	cwts.	lbs.	ozs.	dwts.	grs.
Ground in Britten's machine—						
11th January to 5th October	3	15	9	1,242	16	0
5th October to 3rd January, 1862 ..	2	7	23	1,060	15	0
	6	2	32	2,303	11	0
In Berdan's machine—						
11th January to 5th October	263	19	0	273	1	0
5th October to 3rd January, 1862 ..	185	19	0	207	9	7
	449	18	0	580	10	7
Total for both machines ..	456	0	32	2,884	1	7

If we go over a part of the same time again, and look at the results of the last financial half-year, we have—

	Quantity.				Yielding Gold.		
	Tons	cwts.	qrs.	lbs.	ozs.	dwts.	grs.
Ground in Britten's machine—							
5th October to 5th January	2	7	0	23	1,060	15	0
5th January to 28th March	3	6	1	14*	1,194	10	0
28th March to 4th April	0	6	1	6	126	17	0
Total for half-year........	5	19	3	15	2,382	2	0
In Berdan's machine—							
5th October to 5th January	185	19	0	0	207	9	7
5th January to 28th March	189	14	0	0	198	10	0
28th March to 4th April (lower adit)	10	16	0	0	7	9	0
Total for half-year........	386	9	0	0	413	8	7
Total, both machines in half-year	392	8	3	15	2,795	10	7

These figures speak distinctly for themselves; and if any one in the least degree conversant with miners' work will compare this yield with the costs of four men driving and four stoping, he will see that there are few, if any, adventures in the world that can compete with this on its present scale?

But how long will it last? How far in length will it hold, and how far in depth? He would be an impudent guesser who would venture any estimate in the present unproved state of the district. The richest gold region in Europe is that of Verespatak, in Transylvania: very numerous veins are worked there in rocks, which if not eocene are not older than the chalk,—rocks equivalent, probably, to the Vienna sandstone. It was always feared that these veins would

* This includes the re-working of the "tailings" of the preceding ore, which gave 13 ozs. 7 dwts.

fail in depth; some have done so, but others have cut rich in a deep adit, brought in many fathoms below the old workings, which themselves extend through hills of several hundred feet in height. To the Californian and Australian our Welsh lodes have very little resemblance; they are far more like those of Virginia and Carolina, which have been made the subjects of too much sharp practice to supply us with trustworthy details. Meanwhile, we can only recommend the company to push their exploratory works, which, as the ground is on the average worth 6*l.* to 8*l.* per fathom to break, and then requires no timber, may be carried out a moderate rate.

A second question that suggests itself is, whether the best apparatus is employed for extracting the gold. If large quantities had to be dealt with I should say certainly not, for then a well-constructed stamps, like those of Schemnitz or of Brazil would be indispensable for economical treatment. We know that, by their aid and the rest of the apparatus which is added to them, the Austrian mining managers extract, with advantage, one-eighth of an ounce per ton, and the St. John del Rey makes a noble profit with a quarter of an ounce per ton. Such results would leave a large margin, we believe, to a sufficiently skilled and practical person to work within, who could only make sure, in North Wales, of a sufficient body of tolerably auriferous veinstone to render such apparatus desirable. At Clogau, the apparatus hitherto used, grinding say from 500 to 800 tons a-year, has but a trifling task compared with that of a good range of stamps which will pound you up 20,000 to 30,000 tons in the same time. With a few improvements in the catching of the tailings all seems to work well there for these moderate quantities.

And a last question, also, will suggest itself to many. Is this Clogau the only good thing of the sort? or are we to believe, as some persuasive people wished us to do a few years ago, that every vein and wild-spar course throughout all these older rocks of Wales is capable of forming a prosperous gold mine? Either position is unlikely and untenable. A *single* unaccompanied good lode of any kind in a district is a very uncommon phenomenon; and if any observant man, with an eye for mineral character, compares with auriferous stones which he may have seen, the vein stuff of the blendy Cae Gwernog, of that grand champion lode Berthllwyd, and of the delicate-tinted Dolfrwynogs, he cannot but see that Nature has impressed them with a certain and a very suggestive character. The places mentioned have, it is true, already yielded specimens of gold, and so have a host of other localities in the same neighbourhood; the veins at the Prince of Wales, West Prince of Wales, the Cambrian mine, West Vigra, &c. Most of these lodes have a strong family likeness. Nearly all of them contain a sufficient quantity of finely granular bright galena, or of copper pyrites, to slock the adventurer to the place; but the mining that has been done, with the creditable exception of the Prince of Wales, has been either *nil*, or a mere trifle, or unsystematic and ill-regulated. And yet it is only by a reasonable quantity of steady working that their value for gold can be judged. Capitals of fifty or eighty thousand pounds may be got up for these purposes, or others, but appear to me thoroughly

unnecessary; for the mining is unattended by the heavy costs of engines, &c., needed in most districts for keeping water, and a judicious miner would, I think, in most of these setts, be able before long to conclude how many fathoms of ground he would have to open before he could pronounce on the value of its lodes for gold.

The Cornish Man-Engine.

The appointment of a royal commission to inquire into the condition of the metallic mines of the kingdom has naturally drawn attention to the various appliances by which the labour of climbing ladders may be avoided. It is pretty well agreed that, in the present state of engineering science, some mechanical means ought to be adopted for raising the miners from deep metallic mines; but opinions differ widely as to what those means should be. In Cornwall there is a large party who object to the use of the skip, or any other similar appliance, in the raising of men, principally on the ground of its being dangerous, and who believe that the man-engine is the only machine properly applicable in the varyingly inclined shafts of metallic mines; but there is also an influential party in the county who take a different view, and maintain that with proper care men could be raised with perfect safety in the ordinary skips. As the subject is evidently one of considerable importance, and as an accurate knowledge of the conditions connected with the installation of the man-engine is necessary in order to be in a position to understand the merits of the discussion, we give the following descriptions, most of which are founded on M. Moissenet's memoir in the *Annales des Mines* (5th Series, vol. xv, p. 1), with all additional information as to what has been done up to the present time.

While in collieries, from the earliest times, the workmen have been drawn up by the same means as those used for extracting the coal, this does not seem to have been the case in any metallic mining district in the United Kingdom, or on the continent; in Cornwall, in the Hartz, and in the Erzgebirge, the miners still continue to climb up by ladders. The most obvious cause of this difference is, of course, in the fact that while in collieries shafts are generally vertical, in metallic mines they are commonly inclined at various and frequently changing angles. The original notion of the present form of man-engine was conceived in 1833 by Her Dörell, then at Zellerfeld; and the first engine was placed, in the same year, in the Spiegelthal shaft, 110 fathoms deep. The principle on which the engine was constructed was very simple: it consisted of two rods, to which an alternative reciprocal motion was given, furnished with platforms, from which the miner passed alternately in his ascent or descent. This machine, which received the name of *Fahrkunst*, and was described in Karsten's *Archiv*, vol. x, was found so successful here, that another on a similar principle was put up in 1835 at the Georges Wilhelm mine, on a shaft 225 fathoms deep, underlying

2 feet in a fathom: these were followed by numerous others in various German and continental mines. In the cases mentioned, and indeed in almost every other case, the rods were of wood, like pump rods; but in 1836, when it was proposed to put analogous machines on still deeper shafts, like the *Schreiberfeder Schacht* and the Samson shaft of Andreasberg, it was feared that such rods would be too heavy, and it was resolved in consequence to replace them by wire rope. An arrangement of this kind was placed in the Samson shaft, which, in November, 1841, had attained the depth of 420 fathoms, and which it was expected would have to be sunk to the depth of 480 fathoms. This shaft was sunk on the course of the lode, and from surface to 210 fathoms had an underlie of 6 inches in a fathom; from the 210 to the depth of 300 fathoms it was vertical; below the 300 it took again an underlie of 6 inches in the fathom, but in an opposite direction, to the depth of 330 fathoms, below which it went down again vertical.

The first movement made to introduce these machines into Cornish mines was made in 1834 by Mr. Charles Fox, who offered considerable pecuniary prizes, first to the engineer who designed the best engine, and next to the mine which should erect it. Mr. Michael Loam gained the prize for the best design; and the adventurers of Tresavean mine were induced to erect one, being subsidized by a considerable subscription. This first engine, which went to work in January, 1842, and only extended at first to the depth of 25 fathoms, consisted of two rods (worked by a water-wheel) moving alternately with a 6-ft. stroke, the platforms on each rod being 12 feet apart.

This experiment was so far successful that it was determined, on the advice of Mr. Loam, to apply steam-power, and to extend the machine to the bottom of the mine. For this purpose a 36-in. cylinder engine, with a 6-ft. stroke, was erected—the stroke of the rods being extended to 12 feet, while the platforms remained the same distance apart. Thus modified, the engine was put to work to the depth of 140 fathoms on the 25th October, 1842, and finished to the depth of 290 fathoms in June, 1843; the mine being at that time 310 fathoms deep. A second engine, on the same principle, was put in at the United mines in 1845 by Messrs. Hocking and Loam; it extended to the depth of 210 fathoms, and is still working. Tresavean mine having been abandoned for some years, of course the original engine put up at that mine no longer exists.

The principle of those engines was that of the original *Fahrkunst*—that is, two rods oscillating reciprocally. In 1851, however, the late Captain Puckey, in connection with Mr. West, engineer, of St. Blazey, conceived and adopted a new system at Fowey Consols mine. This consisted in the substitution of a single rod for the double rods—this rod being furnished with platforms 12 feet apart, while a series of sollars, a similar distance apart, were placed in the shaft, on each side of the rod, in such a position as to correspond with the levels of the platforms at the end of each stroke. In this modification of the engine the miner, on leaving the platforms at the end of the up or down stroke, waits on the sollar until the next up or down platform comes to him. This type of man-engine, as we shall point out further on, is a decided improvement on the old

double-rod type, and engines on this plan have since been put up at Levant, Dolcoath, Cook's Kitchen, Carn Brea, Par Consols, and Wheal Reeth. Consequently there are at present eight man-engines working in the county—one double-rod at the United mines, and seven single rods at the mines named. Tabulating the leading particulars of these engines, we have the following statement, which shows the depth to which each engine extends, the particulars of the motive power working it, the relative number of strokes made by the motive-engine for one of the man-engine rods, the rate at which the rods themselves are made to move, the duration of the journey, and the velocity of the miner. In every case the length of the stroke of the man-engine rods is the same—12 feet.

Mines.	Depth of Engine.	Particulars of Motive-engine.			Relative No. of Strokes.	Rate of Man-engine.		
		Size of Piston.	Length of Stroke.	No. of Strokes.		No. of Strokes.	Journey.	Velocity.
	fathoms.	in.	ft. in.	per min.		per min.	min.	per min.
1. United Mines .. (double rods)	210	32	6 0	18	6	3	17½	72 ft.
2. Levant .. .. (single rod)	200	20	3 8	40	10	4	25	48
3. Dolcoath ..	220	20½	5 0	42	12	3½	30	42
4. Carn Brea ..	132	26	6 0	16	4	4	16	48
5. Par Consols ..	220	24	6 0	25–30	5	5–6	20	68
6. Wheal Reeth ..	188	30	9 0	5–6	1	5–6	16½	68
7. Fowey Consols	280	Water-wheel, 30 ft. by 6 ft.				5–6	25	68
8. Cook's Kitchen	190	,, 52 ,, 3				3½	27	42

At the United mines and Fowey Consols the shafts are perpendicular the whole way. At Levant, after underlying slightly east, the shaft changes to a considerable west underlie in depth. At Dolcoath, the first 50 fathoms are perpendicular, but afterwards the underlie is south, 18 inches to 2 feet per fathom. At Carn Brea the shaft is nearly perpendicular to the 80, below which it underlies 1 foot in a fathom south. At Cook's Kitchen the shaft is perpendicular to the 60, and below that underlies 2 feet per fathom south.

Excluding the cases stated of Fowey Consols and Cook's Kitchen, the motive-engines are the ordinary Cornish rotary steam-whims double-acting, with vertical cylinder and beam, except in the instance of Wheal Reeth, where an ordinary pumping engine is used, and the rod is attached directly to the beam. Where a rotary engine is used, the rod is attached to the steam-engine by means of an ordinary balance bob, in the same manner as pump rods would be attached—a line of flat rods of greater or less length being used for forming the connection between them. In the cases of the United mines, Fowey Consols, Carn Brea, Cook's Kitchen, and Par Consols, the flat rods receive their motion from crown-wheels working in a vertical plane; in Levant and Dolcoath, from wheels working in a horizontal plane. This difference of arrangement has arisen from the nature of the motive engines to which the man-engine rods had

to be connected. That at the United mines was used to work a crusher, and consequently the wheels were most conveniently placed vertically. Those at Levant and Dolcoath, on the contrary, having been employed to work the old-fashioned vertical-axe whim, it was necessary to accommodate the movement to them, and consequently Mr. Hocking was driven to adopt the horizontal crown-wheels. The vertical ones are, however, much preferable, and being adapted to the modern form of drawing machine now in use, may be considered as the type to be adopted in future. The mode of connection is very simple: it consists of a crown and pinion-wheel, the latter (say 2 feet in diameter) attached to the axle of the motive power, and the former (say 14 feet), in which this works, to the periphery of which the rod connected with the bob is attached. The dimensions given are those of the cogwheels at the United mines, but, of course, the relative sizes of these will vary according to the relative number of strokes required to be made by the motive-engine to each stroke of the man-engine rods. These wheels are thrown in and out of gear in the ordinary manner, by which the man-engine is connected or disconnected from the motive-engine. In the case of the water-wheel at Fowey Consols, it was considered that its mass alone was insufficient to secure the proper regularity of the motion, and consequently a fly-wheel, weighing fourteen tons, has been added, worked by cogs at three times the rate of the water-wheel.

When the man-engine receives its motion from a vertical wheel, there is no difficulty in making the connection between it and the bob of the man-engine rods, inasmuch as they both work in the same plane. But when the motion is given by a horizontal wheel, as at Dolcoath and Levant, the connection is attended with some little difficulty, in order to bring within as narrow limits as possible the line of lateral variation of the connecting rods. At Dolcoath this is effected in the following manner:—The total distance between the horizontal crown-wheel and the shaft is about 27 fathoms. Between this there is first, an 8-inch rod, 24 feet long, attached at one end to the wheel, and at the other to another rod, at right angles, 22 feet long, working like a fend-off bob. To the point of junction of these two rods is connected the line of rods (7½ inches square) attached to the bob of the man-engine. The effect of this arrangement is, that the lateral variation, which at the head of the first piece of rod is 12 feet (the diameter of the wheel), is reduced by the action of the other rod at right angles to a variation of only one foot, which is not material.

The rods of the man-engines, like those of pumps, are of Norway pine, of the best quality, with an average length of about 36 feet. The size in the rods of the various engines varies as follows:—

Fowey Consols, Levant and Carn Brea..	8 inches through their entire length.
Cook's Kitchen and Par Consols.. ..	Succession of 8 inches and 7 inches.
Dolcoath	Succession of 8 inches, 7 inches, and 6½-inches.
United mines	7½ inches first 60 fathoms.
"	7 inches the 100 following fathoms.
"	6½ inches the last 50 fathoms.

They are joined together like the pump rods, that is, by four

wrought-iron strapping plates, generally about 1 inch thick, 5 inches wide, and from 10 to 12 feet long; these are screwed two and two together with 1¼ inch bolts 18 inches apart, so that each rod is held by eight bolts.

The platforms are of good deal, or oak, which is better, 1¾ inch thick, but of varying size. In the double-rod engine of the United mines the platforms are 18 inches wide by 15 inches deep, with a space of 6 inches between them. In the single-rod engines at Dolcoath and Fowey they are respectively 16 inches and 12 inches square. This seemingly unimportant matter being really one involving to some extent the question of safety, I shall dwell upon it for a moment.

The only danger connected with the man-engine arises from the possibility of slipping the foot, or from carelessness in exposing the head or shoulders beyond the proper limits, and thus subjecting them to collision with the platforms, sollars, or walls of the shaft. Now there is less danger of slipping in stepping on a 12-inch platform than on a larger one; and besides, the more restricted the space, provided it is sufficient for the two feet, the more the miner will be obliged to hold himself upright on the platform, and thus avoid the risk of exposing his head or shoulders to collision with the sollars (in the case of the single-rod engine). The proper space between the two sollars generally would be from 22 to 24 inches. Now with a 12-inch platform there would be on each side a free space of from 5 to 6 inches, while with a 16-inch platform this is reduced to 3 or 4 inches, and consequently the possibility of collision, in case of carelessness, proportionately increased; consequently, a 12-inch platform seems the safest size.

These platforms (which it need scarcely be said should always be horizontal, whatever the underlie of the rod) are fixed in the rod by iron brackets. At Dolcoath this is done by bar-iron, 2 inches by ½ inch, and at Fowey Consols by angle iron. In every engine, a handle of ¾-inch round iron commences 4 feet above each platform, and extends up 2 feet long.

The drawing (fig. 1) on the opposite page, giving a front and side elevation of the single-rod type of man-engine, shows its general arrangement, and the manner in which the men step in and out at the end of each stroke.

Besides these more general particulars, there are a few special details of such practical importance as to make it advisable to give a few particulars concerning them. These are—the guides, sheaves, angle or V bobs for breaking the underlie, catch-pieces, and balance bobs. All these follow, more or less closely, the similar arrangements employed in pit-work.

Fig. 1.

Guides.—The drawings in figs. 2, 3, 4, 5, and 6, show the two arrangements of guides employed at Fowey Consols. One consists of a short bar fixed transversely at the back of the rod, the ends of which work in two longitudinal guides forming a groove; this arrangement is shown in figs 4, 5, and 6, of which fig. 4 is a front elevation, fig. 5 a ground plan, and fig. 6 a side elevation. The

Fig. 2.

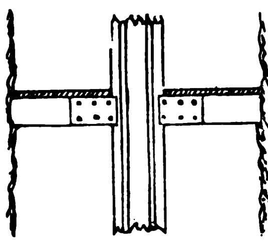


Fig. 4.

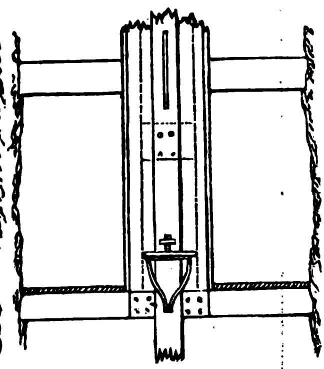
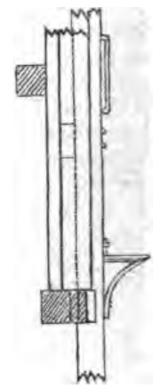


Fig. 6.



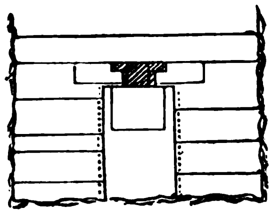


Fig. 3.

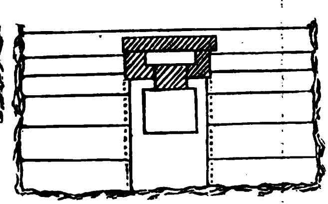


Fig. 5.

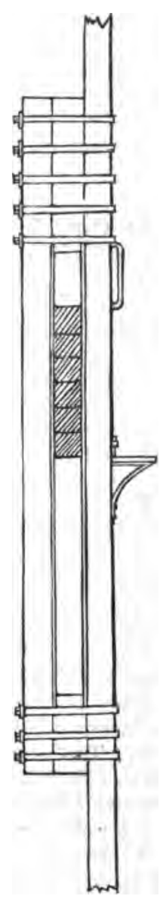
other arrangement, on the contrary, has a short groove in which two long pieces work, which are attached laterally to each side of the rod; figs. 2 and 3 will make this plain. In all cases the rods are protected by linings of beech or elm, and the guides are firmly secured by pieces of substantial timber fixed in the shaft. At Dolcoath for the perpendicular, or only slightly inclined portions, a strong plate is fastened at the back of the rod; this works on a fixed horizontal beam, in which two cramp-irons are placed, which extend over the projecting edges of the plate, and thus form grooves.

Sheaves.—The sheaves are of cast-iron, and are always placed behind the rod in the shafts, firmly secured to pieces fixed in the shaft. Their diameter should not, if possible, be less than 2 feet; at Dolcoath, according to the space disposable, they range from 2 feet 6 inches to 18 inches; the rims should not be less than 3 inches deep. The rod is secured against any vibrations which might cause it to get out of the sheaves by the guides or catch-pieces. A plank of beech, 18 inches thick, used as a lining to preserve the rod from the effects of friction, is fixed by staples on that face of the

rod working on the sheaves. These various guides, including the catch-pieces, should not be at less intervals apart than 10 fathoms.

Angle-bobs.—The most simple angle-bob for breaking the incline is that called the V bob, which is an isosceles triangle, the angle at whose summit is the supplement of the obtuse angle comprised between the two inclinations. These bobs, being those usually used for breaking the angle of pump rods, are sufficiently well understood; it is evident that the points of each of the arms of the V bob describes an arc of a circle whose radius is equal to the length of the side of the V bob, and that upon the length of this radius depends the amount of the deviation. As in the case of man-engine rods, the chord of the arc (the length of the stroke) is always 12 feet, with a 24-ft. bob the deviation will be 9·216 inches.

Fig. 7.



The fixing of a bob of this kind always requires the cutting of a large plat, and has besides, in the case of the man-engine, certain peculiar inconveniences. For instance, in this case it is not possible, as with pit-work, to keep the rod in place between two opposite sheaves, and the deviation causes a vibration which extends for a considerable length; besides, except in the rare case where the change of underlie is but a simple return towards the vertical, the V bob, occupying an obtuse angle, requires a change of the platforms to what was before the back of the rod. These inconveniences have been avoided at Dolcoath by means of a travelling bob with four wheels, the upper pair of which work in vertical guides, and the lower pair in inclined guides. The distance between the angles should be about 18 feet, and represent the length of a right line whose extremities receive a movement of 12 feet, following the sides of the obtuse angle. On the travelling-bob, between the axles, a platform is fixed—the two neighbouring platforms, above and below, being on the main rod.

In certain parts of Dolcoath shaft, where the inclination augments gradually without any sudden angle, the rod coming too close to the hanging wall of the lode, it suffices to keep it sufficiently off, to attach the next piece of rod not to the end of the last piece but behind it, putting a short piece between, and strapping and bolting the whole together.

Catch-pieces.—The accompanying sketch (fig. 7) shows the catch-pieces in use at Fowey Consols, which it will be seen do not differ materially from those used in pump rods, the object being to prevent, in case of breakage, a greater fall than 12 feet, the length of the stroke. These catch-pieces are placed at intervals of 40 fathoms apart, and in the Fowey Consols shaft are composed of six

pieces, each 8 inches square, forming a support 4 feet deep. Behind the catch-pieces another longitudinal retaining piece, 18 feet long, and also 8 inches square, is securely strapped and bolted by iron strapping-plates 2 inches by 1 inch at the top and bottom to the main rod, leaving an intervening space of 12 feet long by 11 inches wide, which is kept by the short intervening pieces, the upper one of which is 4 feet long, and the lower only 2 feet. Both the main rod and the retaining-piece are preserved from friction by the usual lining. It will be seen that these catches work very efficiently as guides.

Balance-bobs.—The rods should be as nearly as possible balanced, so that when they are empty the power required to move them shall be little more than the friction. With the exception of the case of the United mines, presently referred to, the ordinary pit-work balance-bobs are universally used. The amount of balance used at Dolcoath is 30 tons, distributed as follows:—

		Tons.
At surface.—	Balance behind crown-wheel	5
	Large bob at mouth of shaft	8
	Balance at 90 fathoms	7
	„ 120 „	10
		30

At Carn Brea there is a very large bob at the surface, with a balance of 25 tons, and another at the 70 with 7 or 8 tons. At Cook's Kitchen the balance of 20 tons is distributed as follows: at surface, 7 tons; at 42 fathoms, 7 tons; and at 111 fathoms, 6 tons. At Levant there are four bobs with a balance of about 33 tons. At Fowey Consols there are three—one at surface, and two in the shaft. The balance-bobs are usually attached to the main rod by a long connecting-rod, at least 60 feet in length; this length, with the elasticity of the connecting-rod, allows it to be connected with the main rod in the same manner as the retaining-piece in the catches. At Fowey Consols the connecting-rods are of 3-inch round iron.

These balance-bobs work very well, but are costly, not only in themselves, but in consequence of the considerable room they occupy, requiring frequently the cutting of heavy plats where the old workings are not sufficiently large, or not conveniently placed. The latter difficulty may be sometimes met, as in the case of Dolcoath, where, at the depth of 120 fathoms, the lode had been worked for a great width, but with a considerable underlie, so that to put in a bob in these workings it was requisite that it should be inclined like the underlie of the lode and the rod, so as to work in the same plane as the latter. This arrangement is also sometimes adopted with pump rods. The usual system, however, is to put in the bobs behind the rod in a direction at right angles to the length of the shaft. The same well-known principles which apply to distributing the balance in the case of pump-rods also applies to the balancing of man-engine rods; hence it is evidently more advisable to distribute the balance throughout the depth of the rod than to accumulate it in any one place. The main point to aim at is to insure that the rods shall always work by extension and not by compression.

Hydraulic balances would also be evidently well suited for man-engine rods, wherever they can be conveniently used, particularly as they avoid the oscillation which, under the best arrangements, is to a certain extent inseparable from the use of the ordinary bob. At the United mines there are two ordinary balance-bobs at the mouth of the shaft, and three *balance levers* in depth; one at the adit, one at 40 fathoms, and the third 72 fathoms deeper. A sketch of these levers is given in Plate IV. of the *Report of the Polytechnic Society* for 1845. Although the levers are economical in their first cost, there is a considerable friction from the use of cogwheels, so that they have not been found to answer well on the whole, and have not been adopted in any subsequent engine.

Signals.—The man-engine compartment is always provided with a "knocker-line," for signalling to the surface. At Fowey Consols 1½-inch galvanized wire-rope is used.

Weight of Man-Engines.—The density of Norway pine being ·58, a rod 8 inches square and 100 fathoms long will weigh about 4 tons 6 cwt. In the same length there will be about twenty junctions of the rod, the iron used about which, for strapping-plates, &c., each weighing about 6 cwt., gives a total weight of 6 tons for strapping iron per 100 fathoms. The iron required for the fifty brackets for the platforms in the same length will weigh about 7¼ cwt.; and that for the corresponding handles about 3¾. The total weight of a rod 100 fathoms in length will, consequently, be about as follows:—

	Tons.	Cwt.
Wood in the rod	4	6
Strapping-plates, &c., for junctions..	6	0
Brackets and handles.	0	11
Sundry pieces: guides, catches, strapping-irons, bolts, &c.	1	13
Total	12	10

or 25 cwt. per running fathom. If to this we add the travelling or V bobs, and the connecting-rods of the balance-bobs, we have for the depth of Dolcoath, 220 fms., a weight of about 300 tons to be balanced as near as may be by the arrangements stated.

Cost of Man-Engines.—The cost of a man-engine is a matter difficult to estimate with any practical accuracy, for the principal outlay often arises from the cost necessary to put the shaft in a state to receive the engine. Assuming, however, that the shaft is in the required state, we may roughly estimate the cost of the single-rod engine at from £2 to £2 10*s.* per fathom, including in this the balance-bobs taken at an average cost. The mere cost of the rods, platforms, &c. (including strapping-plates and the necessary connections), would probably not exceed 25*s.* per fathom, but the balance-bobs run away with money. One of the most recent engines put up in Cornwall—that at Carn Brea—cost, with the steam-engine (26-inch), about £2,300; but then, as we shall show further on, the cost of the motive power should not be included specially in the cost of the man-engine, for under any system of raising men mechanically this power—indeed, a greater power—would be required. The steam-engine is not necessarily employed exclusively in working the man-engine: when the latter is not working, the former may be used

for drawing, stamping, or any other required duty; the engine at Carn Brea is used for drawing. The estimate of cost per fathom we have given above is not intended to be taken as accurate; it is merely given to convey a general notion, for we intend, on an early occasion, to give the full details of the cost of some of the most recently constructed man-engines in Cornwall.

ECONOMIC CONSIDERATIONS.

Having given the above condensed descriptive notice, we shall conclude by taking a brief review of the following questions connected with this engine :—

The conditions of working, and the results obtained and obtainable;

The types and power of motive-engines most applicable;

Considerations of consumption, expense, and general advantages of man-engines, and particularly of the single-rod type;

And a review of the comparative advantages of the man-engine, and other apparatus for raising miners.

Conditions of working, and results.—In most metallic mining districts the day of twenty-four hours is divided into three *cores* (or *corps*) of eight hours each, thus distributed: from 6 a.m. to 2 p.m., from 2 p.m. to 10 p.m., and from 10 p.m. to 6 a.m., the last core being often wanting. Where a shaft is sinking there are frequently four cores of six hours each, the sumpmen changing at 8 and at 2. To meet these various requirements the engine at Dolcoath is worked thirteen hours out of twenty-four, as follows: from 6 to 9 a.m., from 2 to 8 p.m., and from 10 p.m. to 2 a.m. At Levant they work seven hours out of the twenty-four: from 6 to 7 a.m., from 2 to 6 p.m., and from 8 to 10 p.m.

It follows from this, that man-engines are far from being completely utilised, that is, the rods are never constantly full. In order to arrive at the maximum power of these machines, it will be necessary, for a moment to imagine a working by which they shall be fully employed. As in both systems, the ascending and descending currents go on simultaneously, it will be only necessary to consider one of them.

In the single-rod type every platform may be manned in each up or down stroke, and in the return stroke they can also be manned by those moving in the opposite direction; no platform, in any stroke, need ever be empty. In the double-rod type, on the contrary, the miner only returns to the same rod at every other platform, leaving the intermediate ones as a distinct route for the opposite current; so that, on any one rod, only half the platforms can, under any circumstances, be occupied at the same time.

Now, if L be the length of the man-engine in fathoms, and the platforms be always two fathoms apart, $\frac{L}{2} = P$ will be the number of platforms on each rod.

Let s be the number of strokes per minute made by each rod in the double-rod system, and s' the number of strokes per minute made by the single rod.

Let n be the number of miners to descend; and let t and t' be the corresponding times, in minutes, required to send them down by the double and single-rod systems respectively.

In the double-rod system, the leading miner of the descending current will arrive at the bottom of the shaft after having occupied successively $\frac{P}{2}$ platforms on one of the rods, which will require in time $\frac{\frac{1}{2}P}{s}$ minutes. After the arrival of this leading man of the current, each stroke of the same rod will bring another, so that n miners will be brought down in $\frac{n}{s}$ minutes; so that we have—

$$t = \frac{\frac{1}{2}P + n}{s} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (a.)$$

With the single rod type of engine, where the miner must occupy successively *all* the platforms of the rod, we have similarly—

$$t' = \frac{P + n}{s'} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (b.)$$

Applying these formulæ to a given case, so as to compare the efficiency of the two types of engines, let us take that of a man-engine extending to 220 fathoms deep, having to send down a core of 200 men: here $L = 220$, $P = 110$, and $n = 200$.

In the double-rod type, working at the rate of the United Mines engine, three strokes per minute, where, consequently, $s = 3$, we have, by formula (a)—

$$t' = \frac{55 + 200}{3} = 85 \text{ minutes},$$

the time required to send down the 200 men by this form of engine.

In the single-rod type, working at the rate of Carn Brea engine, four strokes per minute, and where, consequently, $s' = 4$, we have, by formula (b)—

$$t' = \frac{100 + 200}{4} = 77\tfrac{1}{2} \text{ minutes},$$

the time required to send down the 200 men by this type of engine. A result which shows a balance of $7\frac{1}{2}$ minutes *in favour of* the single-rod arrangement, only working one-quarter quicker.

Indeed, a simple consideration of the subject ought to show the great superiority of the single-rod arrangement. For even if the two types of engine worked at the same rate, although the double rod would send down any *one* man in half the time required by the single rod, the time occupied in sending down *any given number* of men would be the same in both cases when the current had been once established. But the double-rod engine *cannot* be worked at the same rate as the single one; for experience shows, that the number of strokes per minute of the former cannot safely exceed half the number of strokes which may be given to the latter: that is, if the one goes 3 strokes per minute, the other may be worked to 6. Accepting, therefore, that while $s = 3$, s' may equal 6, we see that

the single rod will send down any single man as quick as the double rods, and any given number of men in *half the time*, the current once established.*

To get a general formula for ascertaining the number of strokes per minute, s' required to be given by a single-rod engine in order to perform the same amount of work as two rods each making s strokes, where, consequently, $t = t'$, we have from formulæ (a) and (b) —

$$\frac{\frac{1}{2}P + n}{s'} = \frac{P + n}{s'}, \text{ or } s' = 2\,s\,\frac{P + n}{P + 2n} \quad . \quad . \quad . \quad . \quad . \quad \text{(c.)}$$

From this equation it follows:—

1. That s' is always less than $2\,s$;
2. And smaller, in greater proportion for the same depth, as the number is greater;
3. That for any given number s' will increase with the depth.

To make these conclusions more intelligible, let us take the case already given where 200 men were lowered to a depth of 220 fathoms in 85 minutes by a double-rod engine working 3 strokes per minute; and let us ascertain by equation (c) the number of strokes per minute of a single-rod engine would be required to do the same work. Here

$$s' = 2 \times 3\,\frac{110 + 200}{110 + 2 \times 200} = 3{\cdot}64$$

that is to say, a little more than $3\frac{1}{2}$ strokes per minute of the single rod would suffice to do the work in the same time as performed by the two rods working *each* at the rate of 3 strokes per minute.

Assuming that $s' = 2\,s$; and taking the case of a deep mine (say 2£0 fathoms) sending down 500 men per day—200 in each of the day cores, and 100 in the night core—we shall find that while the total time required for sending down the 3 cores with the double-rod engine (working 3 strokes per minute) is 4 hours $32\frac{1}{2}$ minutes, the time required to do the same work with the single-rod engine (working 6 strokes per minute) will only be 2 hours $52\frac{1}{2}$ minutes—showing a saving of 1 hour 40 minutes, or more than one-third of the whole time. Where the motive-engine is employed for other purposes, such as drawing stuff, this saving may be of much importance.

Motive-engines.—In calculating the useful power required to work a man-engine, it is necessary to consider that besides the useful work performed, there is a dead weight to be overcome in the friction and the slight unbalanced weight of the rods. This dead weight of course varies considerably with local circumstances, and particularly with the underlie of the shaft; at the United mines it was estimated that one-third of the motive power was absorbed in the friction resistances.

The weight of a miner may be taken at 150 lbs., and as it is necessary in calculating the power required to assume the maximum that the

* It is rather remarkable that there seems to be a wide-spread misunderstanding in Cornwall as to the respective capabilities of the two types of man-engines. While the single-rod type has of late been exclusively adopted, there seems yet to be a notion that the double rods are able to do twice the quantity of work, and are only not adopted because such an amount of work is not required.

machine could hold, we shall have, taking account only of the ascending current—

In the double-rod system, on one of the rods (take account only of the ascending current) $\frac{P}{2}$ platforms are occupied. During one minute these will receive $2 \times s$ strokes of 12 feet, the useful power (x) of which, expressed in pounds raised one foot high, will be—

$$x = \frac{P}{2} \times 2 \cdot s \times 12 \times 150; \text{ or } x = P\, s \cdot 12 \cdot 150 \quad . \quad . \quad . \quad . \quad \text{(d.)}$$

In the single-rod system, where the whole number of P platforms are occupied during the stroke of 12 feet, we have similarly—

$$x' = P \cdot s' \cdot 12 \cdot 150 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(e.)}$$

Thus expressed, x and x' have the same form, which we can readily understand, for the $\frac{P}{2}$ miners of the two rods are constantly in movement, while the P miners of the single rod are half their time on the fixed sollars.

If we apply these formulæ to the cases of the United mines and Dolcoath, dividing the results by 33,000 to get the horse-power required, we have—

United mines $x = 105 \cdot 3 \cdot 12 \cdot 150 = 567{,}000 = 17\frac{1}{8}$ horse-power
Dolcoath . . $x' = 110 \cdot 5\frac{1}{2} \cdot 12 \cdot 150 = 693{,}000 = 21$ do.

From this hypothesis, which assumes only one ascending current, let us turn to the opposite one, and consider the two contrary currents in motion; we here find that in the double-rod type there is a permanent equilibrium, the same number of miners always occupying the two rods, but inversely changing from one to the other. In the single-rod engine, on the contrary, the equilibrium is alternative, so to say; that is, if the machine is provided with a sufficiently powerful fly-wheel to store up the motive power derived from the weight of the descending miners, this power will be given out again in the following ascending stroke. The excess of the weight of the rod unbalanced produces the same effect—so that in the two stems there is nothing to overcome but the friction.

These observations clearly show the advantages of the single-rod type of engine. If we suppose the shaft vertical, and $s = 2\ s$, we shall find that the friction in the guides, &c., without being entirely independent of this relation, is far from being proportional to it. The single rod, with its double weight, and with a movement equal to that of the two rods, will not have double the friction, while during its work it will bring up and send down twice the number of men.

Practically, man-engines usually work between these extreme limits; all the platforms are not manned, and the contrary currents are not always equal. However this may be, by the adoption of the single-rod machine, we can profit by the motive-power given out by the weight of the descending core by using a rotary engine with a powerful fly-wheel.

As to the type of motive-engine most applicable to the man-engine, it would appear at first sight that, as a reciprocal motion is required, the ordinary form of pumping engine would be easiest

applicable. However, sound practical considerations have proved that for both systems—the double and the single—rotary engines are the most suitable.

The objection which *à priori* would suggest itself to the rotary engine is that at the end of the stroke corresponding to the dead point there is, properly speaking, only a slackening of speed, not an absolute stoppage. No practical inconvenience, however, results from this in consequence of a certain play of the rods due to their elasticity and mass, and to the great slowness of the movement near the dead point.

It is generally held that, with a stroke of 2 fathoms we cannot safely exceed a rate of 3 strokes per minute in the case of the double-rod type of engine, and 6 strokes per minute in the case of the single-rod type. These rates are evidently equivalent as to the time left to the miner, when we consider that in the one case both platforms are movable, while in the other case one is movable and the other fixed. A simple trigonometrical calculation of the arcs traversed by the crank at the various periods of the stroke, and of the time occupied, will give us the space traversed by the rod within such periods, and establish this point. M. Moissenet, in his memoir in the *Annales des Mines* already referred to, has also shown that, by an arragement which he suggests, the single-rod type of engine could safely be worked as fast as even 8 strokes per minute. In this arrangement the comparative rate of the movement of the rod is expedited in the middle of the stroke, but retarded towards the beginning and end; so that, although the total time occupied by each stroke is reduced from 10 seconds to $7\frac{1}{2}$ seconds, the rate at the beginning and ending of the stroke is not increased.

With regard to safety, there can be no doubt that direct-acting engines, leaving an absolute interval of repose at the end of each stroke, would generally be less safe than the rotary engines now used, which only give a very slow movement about the dead point. The man-engine rod, like pump rods, would then have to start suddenly into motion on the admission of the steam into the cylinder, which would evidently give rise to much more danger than the present mode of slow acceleration at the commencement of the stroke.

Another important economical consideration also leads us to decide in favour of the rotary engine. As the man-engine is not required to work continuously, but yet at such frequent intervals that the steam must be always kept up and the engineers on the spot, it is important that the engine employed be of such a type that it may readily be applied to other purposes. Now the rotary engine is the only one so applicable, as the direct acting engine can never be used for any other work than pumping—and indeed, as will be shown further on, it would not even be good for much for this purpose if it were modified so as to be safe for the man-engine. Besides, a steam-engine of the power required to work a man-engine in a deep mine—about 35 horse-power—is just the engine required for drawing from a similar mine. Such a sized engine would be useless for pumping in a deep mine, and, in addition, in an immense majority of cases the pumping is required to be continuous and not intermittent.

In one case in Cornwall a direct-acting engine has been adapted to

work the Wheal Reeth man-engine, by Mr. George Eustice, jun., of Hayle. In this case the arrangement was adopted in order to utilise an old 30-inch pumping engine which happened to be on the mine, and not deliberately adopted as the most advisable course in case entirely new machinery were being erected. As similar conditions may occur in other mines, in whose special case it may be advisable to adopt a single engine working the rod directly, it may be well to state the modifications which Mr. Eustice has used in order safely to apply this form of engine to working a man-engine.

In the first place no expansion of steam is allowed, for this would necessarily be productive of great danger from the sudden shock given to the rod at the commencement of the stroke; the valves are open throughout the whole length of the stroke of the piston. The amount of steam admitted into, and consequently its pressure in, the cylinder is regulated by the engine-man according to the number of men on the rods; if too much steam is admitted the engine will come "in-doors" too fast, and if too little it will come in too slow. In the case of the rod being heavily laden by men going down, it is also requisite to take precautions against its going "out-of-doors" too fast, which would necessarily occur if, at the end of the in-door stroke, the equilibrium valve were suddenly opened with a rod heavily manned. For this purpose a throttle-valve is placed in the top of the vertical pipe connecting the equilibrium valve; by this the rate at which the steam is allowed to pass from the top to the bottom of the cylinder is regulated at will, and with it the rate at which the piston ascends. The whole of this arrangement is very creditable to Mr. Eustice, for circumstances may occur where the adoption of an engine of this kind would be economical, and before he took it in hand it was deemed impossible safely to apply a single-acting engine for the purpose.

Consumption and Expenses of Man-Engines.—It must be evident that the consumption of coals, grease, &c., and the other steam-engine charges, must vary with the varying circumstances; and besides, as the motive-engines are usually employed in doing other work, it is not always easy to apportion the respective proportion of cost which should be set down to each. At the United mines the cost on the man-engine has been estimated at £30 per month. In the case of Levant, where the motive-engine also draws from a depth of 79 fathoms, and where its total cost is £25 5*s.* per month, M. Moissenet calculates that ⅗ths of this should be apportioned to the man-engine, which would give £15 3*s.* per month. If to this we add 17*s.* for grease, &c., used underground, we have a total monthly cost of £16. In the case of Dolcoath, similarly, where M. Moissenet apportions half the steam-engine cost to the man-engine, he gets a monthly charge of £16 8*s.*, which, however, is probably much under the mark. As we shall take the opportunity of giving on an early occasion detailed particulars of the monthly cost incurred in working the various man-engines in the county, together with the number of men transported, and the depths, it is unnecessary to dwell further upon these generalities.

Advantages of Man-Engines, particularly the Single-Rod Type.—The enormous loss of labour and time incurred in climbing ladders is

well known—indeed, too evident to make it necessary to dwell upon it. To go down by ladders to the depth of 250 fathoms a miner will occupy about 40 minutes, and to climb the same distance he will take about 1 hour, or 1 hour 40 minutes in the descent and ascent. In the man-engine he can go up and down in 25 minutes each way, 50 minutes in all, which gives a saving of 50 minutes, or more than $\frac{1}{10}$th, in time of the miner's working day. The saving in fatigue and labour probably amounts to as much more, so that the saving by the application of mechanical means varies from $\frac{1}{5}$th to $\frac{1}{8}$th, and is certainly never less than $\frac{1}{8}$th on the labour expended. This is the mere money question, but besides this there is the question of health.

What has been already said must have sufficiently demonstrated the superiority of the single-rod type of engine; but still it may be well to give a summary of its advantages in a short compass.

1. It is less expensive, and occupies less space.

2. It is safer in several respects. In the first place, the shaft at each two fathoms may be sollared over, only leaving the man-hole, so that in case of a man falling away there would be a fair chance of escape. In the next place, the danger of stepping on to a moving platform is much greater than on to a fixed one; and besides, in case of a man getting giddy, he can rest himself as long as he desires on any sollar, while in a similar case in the double-rod engine he would be carried up and down with each stroke of the engine, which would very likely make him worse and insure his destruction.

3. As it can be worked twice as quick, each man can be sent down in the same time as with the double-rod engine, and the *same number of men* can be sent down in *one-half* the time—when the current is once established—a matter, of course, of immense importance.

4. The power utilised is greater; and as the motive-engine is generally used for other purposes, the amount of time left available for these purposes is greater.

Hence it is evident that the double-rod engine is inferior in every element required. It is necessary to insist strongly upon this, for the fact does not seem to be properly understood by certain Cornish engineers. Its adoption is very creditable to Mr. West and the late Captain Puckey; for while the first engines erected at Tresavean and United mines were nearly copies of the German originals, the Fowey Consols engine started with an independent principle.

To get a general formula for the performances of man-engines, whatever may be the distance of the platforms apart, we have the following, taking d = this distance:

$$t = \frac{L}{d \cdot s} + \frac{n}{s}$$

Putting $d\,s = V$ the velocity of transportation, we have—

$$t = \frac{L}{V} + \frac{n}{s}$$

which shows the time necessary to send down n men to a depth of L fathoms, making s strokes per minute of d fathoms each. The activity will be greatest when the values of d and s are such as to reduce t to a *minimum*.

Comparative advantages of man-engines and other mechanical means for raising miners.—This very important question, which, as has been said, has recently been much discussed in Cornwall, is one on which a good deal may be said on both sides. In favour of the man-engine we have the following considerations:—

1. It is safer—that there can be no doubt about.

2. Being once fixed in place, it will send down or take up a greater number of men in less time, and at a less cost, than can be accomplished by any other means; this is equally clear; for by no other appliance can we deliver a continuous stream of men to a depth of say 300 fathoms, at the rate of 360 men per hour, with engines of the size described.

3. Any man can leave or get into the engine at the level of any sollar, which in metallic mines is a matter of great importance, where workings are carried on at so many different levels.

Against the use of the man-engine as compared with skips or other similar appliances used in collieries, it has been urged:—

1. That although the man-engine may be the safer, yet as it can be so seldom applied (seeing that there are only 8 in Cornwall), its general non-applicability, which still perpetuates so much climbing, really causes more injury to health and life than would be at all likely to arise from the general practice of sending down men in well-arranged skips with wire ropes.

2. That although cheaper and more expeditious when once established, yet, since it necessitates the putting up of special machinery at an extra cost, and above all requires an extra space (not often available), it really brings little economy in the end. On this point, the advocates of the skip also urge that the general application of the same means to raising men as are used for raising ores, would necessarily lead to an improvement of the latter, in which Cornwall is undoubtedly backward, and consequently lead to great economy.

It is quite clear, regarding the matter candidly, that there are points to be urged on both sides. Skips with wire ropes, such as men might be sent down by with *reasonable* safety, ought to be on every mine, and in every working shaft, for the sake of economical drawing alone: man-engines can never be so commonly used. Hence, the rational views would seem to be these:—

1. Where the depth of the mine, the number of men employed, and the general prospects are such as to justify it, and where the extra space required is available without much increased cost, the putting in of a man-engine is the most advisable course.

2. Where these conditions do not occur there is no reason why skips should not be put in, and used with sufficient care, to enable men to be raised and lowered by them. They could never, probably, be made quite as safe as the man-engine, and certainly would not be so economical; but they could be made *reasonably* safe, and under any circumstances would be found cheaper than climbing ladders. In fact, both in the matters of safety and economy, they would be very much better than leaving things as they are—although not so good as man-engines. For instance, by way of comparison, we may admit that a railway is the best of all modes of travelling; but we cannot have railways everywhere, and where we cannot have one, we

may be content with a good macadamized road as better than nothing. So with man-engines and skips; the former may be admitted to be the best when they can be had, but as they are not so universally available as the latter, we must be content to use skips in the great run of mines.

There are only two skips at present in work in Cornwall by which men are regularly sent up and down. One at South Frances mine, in which Lord Kinnaird, the Chairman of the Metallic Mines Commission recently went down; and another at Botallack, by which H.R.H. Prince Arthur went down a few days since.

Illustrated Notes on Prominent Mines.

By the Editor.

EAST POOL.

East Pool is situated in the great mining district of Camborne and Illogan, at the foot and to the north of the granite range of Carn Brea. The metalliferous lodes which course nearly east and west with this granite hill to the north of it, for a length of upwards of 2½ miles, from the boundary of Redruth parish to Camborne town, may be classed into four zones, which, taking them from south to north—that is, in succession as they recede from the granite—are as follows:—

1st zone, nearest the granite, which comprises the mines of Carn Brea, Tincroft, part of East Pool, Cook's Kitchen, Dolcoath, Stray Park, and Camborne Vean. In this zone the backs of all the principal lodes are in the killas, but they all enter the granite in depth—generally above the 110 fathoms below adit. In the northern part of this zone there are several elvans, which principally dip away north from the granite; and in the middle of it, between the south and north runs of lodes, a regular underground ridge of granite has been traced, rising at places to within 70 fathoms of the surface.

2nd zone, comprises Wheal Tehidy, part of Wheal Agar and East Pool, South Crofty, and South Roskear. There are several elvans in this zone, but no granite had been met with until the recent discovery at East Pool, which I shall refer to further on.

3rd zone, which comprises North Pool, part of Wheal Agar, North Crofty, and North Roskear. Elvans are also met with here.

4th zone, comprising West Tolgus, East Seton, Wheal Seton, and West Seton.

Of course such a division as this is arbitrary, particularly where there are caunter lodes running from one zone into the other, as in the case of the great caunter lode which extends from Pool through North Crofty to Old Wheal Crofty into Wheal Seton. But still it is convenient, and will aid to give a notion of the position of the various mines, and their relative distances from the granite.

The transverse section shown in plate 5 is drawn across Carn Brea and East Pool setts, and shows Teague's lode, Fanny lode,

Highborough lode, and East Pool south lode, classed in the 1st zone; and East Pool north lode, classed in the 2nd zone. The section is not entirely in the one line, for the portion of Carn Brea sett in which the 60 and 80 cross-cuts north are driven is not opposite the 48, 70, 100, and 120 cross-cuts in East Pool: indeed, this East Pool south lode (or Tincroft north lode) crosses at a small angle the boundary between East Pool and Carn Brea, and is, for a portion of its length, in the latter sett—to which portion the 60 and 80 cross-cuts shown were driven. The difference, however, arising from the section not being all in the same plane, is not material, and in no way affects the general view the section is intended to give.

Dipping down from Carn Brea hill, it will be seen that the granite intersects Teague's lode and Fanny lode (south underlyers) at the respective depths of 50 and 80 fathoms below adit, the Wheal Fanny shaft passing into the granite at the 70. In this line the granite seems to dip about 20 fathoms deeper, when it takes a rise again upwards, going considerably above the 60 cross-cut north, which has been driven through it to East Pool south lode, where the granite again dips pretty rapidly north, forming the south wall of that lode as far as has been yet seen. This underground ridge of granite, which for the sake of distinction I shall call the "first ridge," can be distinctly traced for at least a mile and-a-half running parallel with the main ridge of Carn Brea; in Dolcoath it occupies precisely the same position as in Carn Brea, although it appears not to be quite so large.* The occurrence of a tolerably large, and for a considerable distance so regular underground ridge of granite, has always seemed to me to be a matter of peculiar interest—worthy of much greater attention than it has yet received, for it seems to indicate conditions in the eruption of granite which have not been hitherto understood.

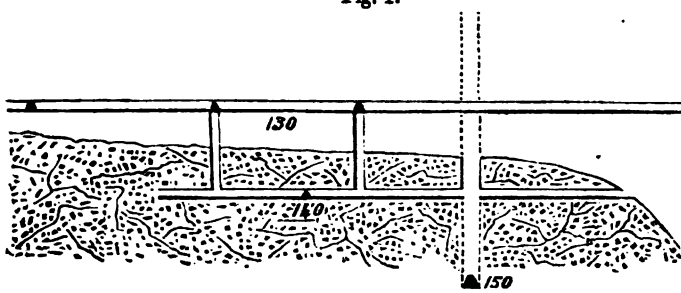
But the interest which attaches to this first ridge is much enhanced by the discovery of a second ridge lying still further north recently made in sinking the north engine-shaft at East Pool. This shaft, as will be seen by the transverse section, is sunk perpendicular to the depth of 5 fathoms below the 120, where it intersects the north lode. Upon the intersection of the shaft with this lode it was proposed by some of the adventurers to continue the sinking of the shaft on its underlie. Fortunately, however, at the pressing instances of the manager, Captain W. S. Garby, this was not done, for if it had the recent discovery would not have been made—at least at present. It was agreed to continue the sinking of this shaft perpendicular; and in about 15 fathoms sinking, that is at about 5 fathoms below the 130, it came down suddenly on granite, and at the same time on one of the most extraordinary bodies of mineral ever met with in Cornwall, which upon being cut into north turned out to be a great lode, upwards of 12 feet wide, made up of mundic, copper, tin, and wolfram, in great quantities.

Subsequent explorations have shown that just above where the shaft intersected the lode a "dropper" a few inches wide went off,

* Compare the cross-section given in Captain Charles Thomas's "Remarks on the Geology of Cornwall and Devon," p. 19.

underlying north. This dropper, as seen by winzes since sunk upon it, continued as little more than a string until about 4 fathoms below the 130—that is, 6 feet above the granite—when it *quite suddenly* opened out into a lode 12 feet wide, underlying a little north. The accompanying section (Fig. 1), on a scale of 22 fathoms to 1 inch,

Fig. 1.



shows the extent to which the workings have been extended on this new lode. Going east in the 140 from the shaft, the granite is found to dip, and in about 18 fathoms driving the level is again in killas, where the lode is found to decrease to a mere string. Going west, the granite rises towards the 130, but not very rapidly, as will be seen from the section. From the 130 to the 140 two winzes have been already communicated, and a third is about being commenced, in the position shown in the section, to come down on the 140 end west. A cross-cut has also been commenced from a point between the two winzes already communicated, which is being driven south to intersect the continuation of the old north lode; this lode has been sunk on 7 fathoms deep below the 130, as shown in the transverse section, where it is 8 inches wide, and rather promising looking. The cross-cut has been driven about 6 fathoms, and has about 4 fathoms more to drive to cut this lode.

The engine shaft is now down to the 150, and the cross-cut north to the new lode is being driven with all speed, which it may be expected to cut early in June. The result of this level is looked forward to in the district with great interest, not merely by those interested pecuniarily, but by all parties. Great differences of opinion exist as to the probable continuance of such a large lode, opening out as it has done just on the junction of the killas and granite, for a permanency. The lode in the granite already opened on has been rich for tin and copper, but these have been mixed up so much with other minerals—particularly with wolfram—that their commercial value has been much deteriorated. At one point of the lode, in the stopes below the 140, on the north, there is a mixed course of tin and copper 9 feet wide, worth £75 per fathom, on the south side of which there is a solid branch of wolfram 4 feet wide, interspersed with a few strings of copper and mundic. The opinion of those most interested in the mine—with whom, no doubt, "the wish is father to the thought"—is that the wolfram and other impurities, which are now so troublesome, will die out in depth, leaving a large

and rich lode of copper and tin. I sincerely hope that this may turn out to be the case; I think there is a very fair probability of its being fulfilled. The opinion of those who take an adverse view is that the deposit is in the nature of a "floor," forming at the junction of the killas and granite; but in the stopes at the bottom of the 140* there seems no indication of any falling off.

Turning, however, from these questions of merely personal interest, let us look at the bearing of this discovery on the district in general. If we take a broad view we find that almost all the main lodes have made rich at some point or other more or less shallow; but unless they can get into the granite there seems no chance of rich deep mines. Mines in the second and third zones have made rich to some considerable depths, but mostly in connection with elvans. At South Roskear and North Roskear the lodes have intersected two main elvans: above the first, both mines were rich; between the first and second they have about paid cost; below the second they have been poor. The mines of the fourth zone seem to make more in connection with a great run of greenstone which flanks the granite at some distance off.

The proximity of the granite to the lodes of the northern zones in depth is consequently a matter of the greatest interest in a view of the future of this district. In Dolcoath, Cook's Kitchen, and others of the 1st zone, the mines are turning out richer at the depth of 300 fathoms than they ever were above, although they have returned mineral produce to the value of millions upon millions. There seems every probability of mines reaching a depth of 400 fathoms in this zone; indeed, with a high price for tin, they seem practically inexhaustible for a couple of generations; and the only difference between the lodes in this zone, and those of the two to the north, is that in the first they have entered the granite, while in the latter they have not done so. If the lodes of the northern zones are likely to enter the granite within practical mining depths, who shall say that they will not be equally rich, and that this great district, which has already done so much, is not in its infancy for real deep mining—mining below a 250 or 300-fathom level?

The difference which the rising up of the ridges causes in the depth at which the lodes may reach the granite is easily estimated. If the granite of Carn Brea continued to dip regularly as it does from the surface to its intersection of Fanny lode, it would not catch the Highborough lode until the 180 instead of the 60; and as to East Pool north lode, which has now got the granite at the depth of 135 fathoms, it would not intersect it under a depth of at least 500 fathoms—in which case the large lode recently found, which evidently makes in connection with the granite, would never have been seen. Even if the first ridge had continued its regular dip, the lode would not have reached the granite before the 220. If this second ridge rises still more going north, as indicated by the dotted line, and which seems to be the case, the lodes of the northern zones may be much nearer the granite than has been suspected.

* The necessities of the mine have obliged some fathoms of ground about the engine-shaft, 7 fathoms on the west and 8 fathoms on the east, and 3 fathoms deep, to be stoped underhand.

It will be seen that the East Pool south lode runs down all the way on the junction of the killas and granite, having the former on the north side and the latter on the south side. This is a mode of occurrence which is common enough in Cornwall, and it seems to me well worth considering whether or not we should deem this lode to be a fault, throwing down the granite 90 fathoms south. If it is to be considered a fault, then the second ridge of granite must have been originally much nearer the surface than it now is. This and several similar phenomena in Cornwall are certainly worthy of a much greater amount of attention than they have hitherto received.

Abstracts and Reviews.

MR. JUKES' MANUAL OF GEOLOGY.

The Student's Manual of Geology. By J. Beete Jukes, M.A., F.R.S., Local Director of the Geological Survey of Ireland, and Lecturer on Geology to the Museum of Irish Industry. Edinburgh: Adam and Charles Black.

In this *Manual* Mr. Jukes classifies his subject under the three following heads:—1, Geognosy; 2, Palæontology; and 3, The History of the Formation of the Series of Stratified Rocks. Under the head of Geognosy, he classifies the study of the structure of rocks independently of their arrangement into a chronological series, subdividing the subject into two parts—Lithology and Petrology; meaning by Lithology the study of the mineral character and texture of rocks, and by Petrology the study of the larger characteristics of rock masses—their forms, positions, mutual relations, and other characters that can only be studied in the field—but without entering on the question of the geological time of their production. This Geognosy division, which occupies half the volume, is, as we have already said, the characteristic feature of Mr. Jukes' work. The title is well chosen, for the sense to which the author here limits it is about the original meaning of the now (in this country) exploded word geognosy. On the Continent, by some writers particularly, it has received a wider sense, being made to include to a great extent what we generally understand by geology—the latter word being only used as describing the *Past* History of the Earth. Thus Naumann divides geology into two parts—Geognosy and Geogeny, only giving the former name to his great work, which is really the most complete and exhaustive treatise yet written on the science of geology. The nomenclature of the two subdivisions of Geognosy is not altogether so satisfactory. The name Lithology, as applied to the study of the mineral character and texture of rocks, is unobjectionable; but the use of the word Petrology, in the sense employed by Mr. Jukes, is rather confusing, as the word Petrography is commonly used in about the same sense as he uses Lithology. Certainly "Petrology" does not at once suggest to the mind the subjects to which Mr. Jukes' definition applies it, and we think he could find a better name for this division of his subject: "Geotektonick" is the word Naumann uses for this section of Geognosy, and although the nomenclature of this author may seem to us over pedantic, and savouring too much of the excessive classification in which German minds delight, there are still great advantages in following as nearly as possible such a great classical work as his "Geognosie," and con-

sequently we think that some modification of "Geotektoniek" would be preferable to Petrology.

Turning to the chapters treating of Lithology, we find a sufficiently full and reasonably clear description of the chemical composition of the principal rock-forming minerals. It is a remarkable thing that there are but few people, even among geologists, who have any clear notion as to the chemical constitution of rocks, or are really aware how essentially simple their composition is. Generally speaking, it seems to be imagined that the mineral crust is composed of a jumble of almost all the elements—a notion certainly favoured in the student's mind by mineralogy books, which place on the same footing minerals like quartz and the felspars, and species of which a few ounces only have ever been found. Hence the chapter in this *Manual* on the chemical composition of rocks supplies a decided *desideratum*. We cannot say we think that Mr Jukes is fully alive to the most recent advances made on this subject on the Continent, or that he takes a sufficiently broad view of the genesis and transitions of mineral species (so-called); but as these are still matters of controversy they are probably wisely excluded from a work intended professedly for students.

The truth is that the real scientific study of mineralogy has been retarded half a century by the mistaken course given to that science by a few eminent men, whose aim has been to isolate mineral species by an excessive and often artificial classification, and to dwell rather upon their differences than to search out their analogies and mutual relations. This is due, to a great extent, to what we venture to call—even at the risk of being misunderstood—the excessive importance attached to crystallography. If we regard minerals in a geological sense—that is, if we take a wide scientific view—it is evident that we must look more to their chemical composition and paragenesis than to their crystalline form; and consequently the exclusive importance which has been given to the latter has led us away from the true track. Without undervaluing crystallography, or doubting that it will *ultimately* be found of inestimable scientific value, it must be remembered that *at present* it has no great value beyond that of aiding the recognition of species. Until we know the reasons why certain species take certain forms, the value of crystallography in elucidating the larger problems of mineralogical geology may be considered as non-existing. Indeed, the old mineralogists, who regarded mineral species merely as rock constituents, and considered their description as only preliminary to a description of the latter, were nearer the truth than the authors of modern mineralogy books; for a study of minerals in their relations as rock constituents leads us to the great problem of this branch of geology—the paragenesis or association of minerals.

The paragenesis or association of minerals is a subject not merely not generally understood, but it is one of which we may safely say few people know the existence. With the exception of Breithaupt's work,* a few memoirs scattered through German periodicals, and we may probably add a portion of M. Delesse's memoir "On Pseudomorphs," in the *Annales des Mines* (sixth series, vol. xvi, p. 317), there is scarcely any literature on the subject. Yet it is of all others the most important branch of mineralogical study, for nothing is more certain than that minerals are not associated together *promiscuously* in rocks or veins, any more than are the chemical elements in the constitution of minerals: there are certain laws of association, or paragenesis, regulating the "occurring together" (*Zusammenvorkommen*) of mineral species, of which we have as yet but a faint glimmering, but which, when fully investigated and understood, can scarcely fail to throw a flood of light on the laws regulating their origin. This is the

* Die Paragenesis der Mineralien. Von Prof. Dr. August Breithaupt. Frieberg, 1849.

widest meaning of the word paragenesis; but it is very generally used in a narrower sense, although one not without interest and importance, which regards rather the "succession" (*Sukzession*) or the relative order of crystallization of minerals—and in this sense it seems to be employed by Mr. Jukes. As Breithaupt truly says, the study of the paragenesis of minerals is one essentially connected with that of metalliferous veins. With the metallic miner it originated, and by him alone is it really studied —generally unconsciously. When a miner says that the occurrence of a certain mineral species or a certain family of minerals is "kindly" for the production of another mineral family of economic value, he enunciates a paragenetic law, and really possesses a knowledge (confused, no doubt) of a higher branch of mineralogy than is dreamed of in the more correct but decidedly narrow philosophy of the cabinet mineralogist who, however glibly he may "chatter stony names," and however anxious he may be to teach the miner his little science—necessary enough in its way—always fails to impress the latter with his knowledge. The miner knows right well that he possesses more real knowledge than his would-be teacher, although he is incapable of expressing it, and has, probably, never indeed formulated it in his own mind.

In considering rocks, Mr. Jukes classes them under four heads—Igneous, Aqueous, Aerial, and Metamorphic. The Igneous are all chemically formed; the Aqueous may have either a chemical, mechanical, or organic origin; the Aerial are all mechanical, while the Metamorphic are those which belonged originally to one of the foregoing classes, but have been "altered" by subsequent action. This is a good practical classification, but scarcely capable of being carried out scientifically. Indeed, no single classification can include the consideration of every circumstance connected with the origin of rocks; our classification must vary according to the point of view in which we are to regard them. If we look to the materials from which they were derived, we may class rocks into *Minerogene*, *Zoögene*, and *Phytogene*, according as their principal source is mineral, animal, or vegetable. According to the probable mechanical conditions of their origin, we may class them as *Eruptive*, *Klasticine*, or *Metamorphic*, for it is evident that all rocks have either been thrust up from beneath, thrown down from above, or been altered in place. The word klasticine (from κλαστός) used above we have ventured to borrow from the French and German geologists by whom it is frequently employed, as it seems highly convenient, there being no word at present in use answering to it, for the word sedimentary implies a deposit from water, and that in a fine state, thus excluding all aerial-formed rocks, and those made up of large fragments; while the distinction of chemically and mechanically originating rocks is too indefinite to have any scientific meaning. We may again class rocks as aqueous, igneous, or aqueo-igneous—*hydatogene*, *pyrogene*, or *hydatopyrogene*—although as a rule it is better to avoid founding a classification on geological questions of this kind, which imply a theory. For this reason we object to the word "igneous" employed by Mr. Jukes, and by the geological survey, as designating the great body of crystalline rocks, for, to say the least of it, its most obvious meaning involves assumptions upon which recent inquiries have thrown great doubt; the word "eruptive" would be much more satisfactory. We think, also, that the term "klasticine"—used in a sense to comprise all rocks thrown down from above either mechanically or chemically—might with convenience be used to include the aqueous and aerial classes of Mr. Jukes. No doubt there is an inconvenience in introducing new words, but this inconvenience is less when they are already in use by the standard authors of foreign countries.

However, these are very minor matters. In the classification of rocks and the discussions as to their mode of origin, this *Manual* is decidedly the best English elementary work. There is a freshness about the descriptions,

and a knowledge of valuable details and distinctions, which mark the experienced field-geologist, and give them a peculiar value to students of economic geology.

Turning from the chapters on Lithology to those on Petrology we find Mr. Jukes even still more at home with his subject. Occupying as they do 300 pages of the volume, we can safely say that in no other English elementary work can the same information be met with. From Mr. Jukes' experience among the coal fields of the Midland Counties, he is enabled to give us an unusual amount of illustration of great practical importance on the faults and disturbances met with in the carboniferous rocks. A great number of the illustrations, too, are derived from Irish localities, many of which are very interesting as the geology of that country is not very generally known. Ireland seems, from the number of instances given, to be particularly rich in the jointed structure of rocks.

To miners the chapter on Faults or Dislocations will be found of great value, for the matter is not generally as well understood as it should be. In it Mr. Jukes gives another example of that rare occurrence, a reversed fault—an occurrence, however, which, although rare, is scarcely so very exceptional as Mr. Jukes seems to consider it. An instance of one was shown in Mr. Fryar's paper in our April number, and the additional example given by Mr. Jukes is from a colliery in the Queen's County.

The chapters on Cleavage and Foliation, on Denudation, and on Unconformability and Overlap are full of interesting matter, some of which is quite new. The chapters on the geognostic characteristics of the eruptive rocks are also full of interest.

In the chapter on Mineral Veins (which would be more correctly Metalliferous Veins) we naturally look for little more than a simple statement of some of the best known facts, and these we have. We know so little on this subject, and so much of what we supposed to be accurate knowledge turns out to be mere hearsay and entirely worthless, that the probability is we shall have almost to begin *de novo* in our inquiries. We certainly have the writings of Mr. W. J. Henwood and Mr. Warington Smyth, which are entirely reliable—both being practical men, conversant with underground operations; but neither of these gentlemen have favoured us much lately. Many, indeed most, of the inquirers into the phenomena of metalliferous veins have been content to take their information at second-hand; in fact there was no other course open to them, for the examination of underground workings by persons unaccustomed to them is a mere farce. It requires an apprenticeship of years before a man can be competent to decide on minute facts in the dirt and gloom of a mine, and the labour which that involves is a matter none have been found to go through but as a matter of business.

Mr. Jukes is quite right in pointing out that there is no connection between the age of rocks and the occurrence of metalliferous veins, which may be expected in rocks of all ages where the necessary disturbing and metamorphosing actions have taken place. But we think he goes too far when he denies that there is any relation between metalliferous deposits and certain classes of eruptive rocks, or "igneous" rocks as he calls them. It must of course be admitted that we have not yet been able to trace any relation capable of being scientifically defined; but still the experience of the greater part of the world, showing a general connection between certain eruptive rocks and certain classes of metalliferous veins, is too strong to be lightly passed over. *Mineral* veins occur in almost every kind of rock, and frequently necessitate for their production all required conditions of disturbance, but these are not necessarily metalliferous. In connection, however, with certain classes of eruptive rocks (rocks known to miners as "congenial") these veins do become metalliferous, showing seemingly a certain paragenetic relation between these classes of rock and certain

metalliferous minerals. Of course this association may be accidental, and we should be slow to found on it rash hypotheses ; but, on the other hand, it is not to be put hastily aside.

The next chapter on "The Art of Mining" is, of course, merely popular, but it puts prominently forward the distinction between Bed Mining and Vein Mining, which miners themselves frequently fail to keep sufficiently distinctly in view. This concludes the First Part, and brings us to the Second, which treats on Palæontology.

In devoting a special division to Palæontology before entering on the description of the Series of Stratified Rocks, Mr. Jukes follows the example of Naumann—as he does indeed in the general arrangement of his volume. The advantage of this to students is, of course, immense, for here they can learn in a consecutive form the leading facts and principles regarding the revolutions of life on the globe instead of picking them up bit by bit in the course of the volume. In the three chapters which are devoted to the subject in this *Manual*, the reader will find one of the clearest and most philosophical expositions of palæological doctrine easy to be met with in such a small compass. On the philosophy of geology Mr. Jukes is in the advanced ranks of the holders of Lyellian doctrines, and consequently we meet with none of those ancient prejudices which so warp the judgment of other able geologists. Since the last edition of his work he has evidently been affected by certain recently-propounded doctrines on biological science and being—like his colleague, Professor Huxley—of that "honest few" who scorn to blind their judgment in order to fall in with the popular current of the hour, he indicates his opinions fairly, without ostentation or without reserve.

Part III., the "History of the Formation of the Crust of the Earth," which occupies nearly 300 pages, is much improved compared with the last edition, in which there were no illustrations—either sections or figures of fossils—which in the present edition are abundantly given. This part teems with new matter, a good deal of which is, of course, derived from the Survey.

The whole concludes with an appendix on Geological Surveying, which will be found of much value to practical men. We may add that there is a most copious index, a matter of the utmost importance in a work of this kind, making it a dictionary of geological reference.

SOCIETY OF ARTS.

At the meeting of this Society on the 14th May, Thomas Sopwith, Esq., M.A., F.R.S., in the chair, the following paper was read:—"Gold Mining and the Gold Discoveries made since 1851." By J. Arthur Phillips, Esq.

It would be obviously impossible to attempt to give within the limits of the present paper, a detailed account of all the valuable gold discoveries which have been made within the last ten years, and I shall, therefore, necessarily confine myself to the more important only, but shall, at the same time, briefly notice the various modifications which experience has introduced into the processes for treating auriferous ores, and succinctly advert to some of the causes which have unfavourably influenced this class of industry. Gold is usually found in a quartzose gangue, traversing altered palæozoic shales, and these deposits are frequently richest in the vicinity of eruptive rocks. The oldest stratified rocks have been seldom found auriferous, but the sedimentary deposits which follow in the series (those generally ascribed to the Silurian, Devonian, and Carboniferous epochs) have, particularly when highly metamorphosed, yielded the largest amounts. Of these, those usually described as Silurian rocks have been by far the most productive, but instances are not wanting, even in Europe,

of small quantities of the precious metal having been found in the conglomerates of the Carboniferous period.

Gold almost always, if not always, occurs in the native or metallic state; generally in the form of small flakes or granules, but occasionally in masses of considerable weight. It is never pure, being invariably alloyed with silver, and frequently contains small proportions of iron and copper. Gold is also often associated with various metallic sulphides, such as copper pyrites, galena, blende, and particularly with iron pyrites, and mispickel. It appears somewhat doubtful whether, in every instance, all the gold in metallic sulphides exists in the form of minute metallic particles, or if, in some cases at least, it may not be present in combination with sulphur. I may, however, observe that from the results of numerous experiments on this subject, I am inclined to the belief that gold does sometimes occur in small quantities in the form of sulphides, but that oxide of gold, for the extraction and utilization of which sundry much-vaunted processes have been devised, does not exist in any of the known auriferous ores. The extraction of gold from the sulphides would by the ordinary process of amalgamation, present considerable difficulty, and consequently, it will often be found advantageous to separate and collect the pyrites, &c., contained in the tailings, and subsequently to subject them to metallurgic treatment by fusion either with galena, litharge, or some other lead product.

The most important gold discoveries made during the last ten years are those of British Columbia, New Zealand, and Nova Scotia; but it may also be observed that gold in paying quantities has been recently discovered in the neighbourhood of Dolgelly, in North Wales.

British Columbia.—As early as June, 1856, Mr. Douglas, the Governor of Vancouver's Island, reported to the Secretary of State the discovery of gold in the British territory, north of the 49° of latitude, and stated that the earnings of the diggers ranged from 2*l.* to 8*l.* a-day. In consequence, however, of the hostile attitude assumed by the natives, the number of diggers was very limited. Altogether this discovery attracted at first less attention than might have been anticipated, but in December, 1857, Governor Douglas reported that the Indians themselves were extensively engaged in the search for gold, and that the accounts which had reached the neighbouring states of America had caused considerable excitement. It was not, however, until May, 1858, that a stream of immigration sufficient to overpower the opposition of the aborigines had fairly set in, and the British public learnt, for the first time, that the mainland of New Caledonia, as the district extending from the Red River to the Pacific was somewhat vaguely designated, was a rich and beautiful land, which gave every promise of becoming a flourishing and highly important colony.

The *Times* correspondent, writing from Victoria, Vancouver's Island, under date of January 20th, of the present year, says:—"Beginning with Fraser River, the main artery of the auriferous region, I may state that gold is known to exist, and has been worked at a great many places in the river and on its banks, from a point about 45 miles from its mouth up to near its source in the Rocky Mountains; in other words, from the 49th up to the 53d parallel of north latitude, a distance (taking in the windings) of some 800 miles. The south branch of the Fraser has its source near Mount Brown, in the Rocky Mountains, in about 53° north latitude, 118° 40′ west longitude. Thence this branch flows for 290 miles to Fort George, a post of the Hudsons' Bay Company. The north branch rises in an opposite direction. It receives its supply from a series of lakes lying between 54° and 55° of north latitude; longitude about 124° 50′ west, and runs a course of 260 miles to its junction with the south branch, some miles below the 54th parallel of north latitude. Here the union of the two branches form the Fraser River proper. Adding the north branch, which

is also a gold-bearing stream, and which was worked last season, to the other arm, the two will give us a continuous stretch of auriferous riverain territory upwards of 1,000 miles in length, extending for many miles back into the country, but not including the tributary rivers which fall into the Fraser. In short, the river itself is now known to be auriferous, and to pass through a gold-bearing country throughout its whole course. Gold is also found in most of the tributaries of the Fraser, of which no less than 59 are known. The great length of the main river, and the number of its tributaries, will give some idea of the auriferous resources of the country. But these facts do not by any means convey a comprehensive or accurate view of the vast extent of the area of the gold field, because they are limited to the central portions of the country, while the whole of the upper portion of British Columbia, from its southern to its northern boundary is auriferous. Besides the gold found in the beds and on the shores of these streams, the Fraser itself and many of its tributaries are skirted and bordered by terraces, all of which yield gold also. These terraces, or benches, as the miners call them, run at intervals along both sides of the rivers for miles in length, and they recede where the mountains retire for distances back into the valleys varying from a few acres to a few miles in breadth. They are objects of curiosity and speculation, and add much to the beauty of the rude scenes in which they occur, from the regularity and evenness of their structure. They generally occur on both sides of the river (opposite to each other) at the same place, sometimes at the same elevation on both sides, and sometimes at different elevations, high on this and low on the other side of the river, and in some places they are multiplied into several successive level parallel plateaux, rising one above the other as they recede from the bank. These terraces are composed of the ordinary alluvial deposits, loam, gravel, stones, sand, and boulders, and they are thick masses, rising generally to a height 150 to 200 feet."

From the statement of the same writer, there would also appear to be abundance of gold found in other localities besides the vicinity of the Fraser. Large yields have been obtained from the diggings between Fort Hope and Fort George, about 100 miles from its mouth. These mines are said to have yielded during the last season an average of $17 to the hand, and a party of three men fook from three days' digging $240. At Okanagan, 60 miles distant, the average produce is stated to have been $4 to the hand. The Thompson River and its tributaries had also proved highly auriferous. North River gave from $8 to $10 to the hand, and on the Barrière a community of French Canadians made each as high as $50 per diem. Cariboo, however appears to be the largest and richest of all the gold districts hitherto discovered. In confirmation of this, it may be stated that at Steele's claim, Williams's Creek (Cariboo), a company of five partners commenced their operations during the summer months. They began their preparations by sawing timber for their sluices, and at first their claim did not promise so much as many others. During the first three days they obtained little or nothing, but on the fourth day their labours were rewarded by the collection of 4 ozs. of gold. On the fifth day they made 10 ozs., and on the sixth 41 ozs. From that time the yield went on increasing until it reached 387 ozs. per day, whilst the last day's work gave them a return of 469 ozs. The five partners employed four hands to assist them in clearing away the tailings. The labourers were paid $8 per day each, in addition to their board, and the total value of the gold raised during not more than two months' actual work was equal to a money value of 21,875*l.* The total area of the claim so worked was 80 feet by 25 feet, thus showing the extreme richness of some of the deposits of British Columbia.

New Zealand.—Early in the present year accounts reached this country

of gold discoveries having been made in New Zealand, and although, so far as I am aware, no very detailed reports of the method of its occurrence have been yet received, there is every reason to believe that remunerative deposits of the precious metal have been found in this colony. A letter published in the *Daily Telegraph* in March last states :—

"The great influx of gold into Dunedin from the Otago gold fields still continues. On November 22nd and 28th, and on December 15th last, the escorts conveyed respectively 21,000 15,000, and 14,000 ozs. The total number of gold brought down by escort up to December 20th, is 191,831 ozs., which, at 3*l*. 17*s*. per oz., is of the value of about 738,550*l*. This is independent of what has arrived here through private hands. New diggings are continually being discovered in the locality." It also goes on to say that, "It will not be long before New Zealand will be recognised as a gold-bearing country, for it is known that the whole of its mountain ranges are auriferous, from the south to the extreme point of the north." The *Otago Daily Times*, of February 17th, has the following remarks on the rapid process of that settlement, consequent upon the discovery of gold fields in the immediate vicinity :—"The population of Otago is on the increase, and the gold fields continue to prove very productive to the number of miners engaged in working them. Every day tends to prove that gold exists in paying quantities over a large portion of the province, and that gold mining will continue to form a profitable pursuit to a large population for many years to come. The most noticeable event during the last month has been the discovery of a new gold field on the Lammerlaw Creek, near its junction with the Waipori. Opinions respecting it are more or less conflicting, but the general belief is that it will prove a valuable addition to the already-opened gold fields."

I am not in possession, however, of any special information relative to this colony, and shall, consequently, pass on to notice the gold fields of Nova Scotia, which I have recently visited and with which I am, therefore, better acquainted.

Nova Scotia.—As the portion of Mr. Phillips' paper on the gold fields of Nova Scotia has, in substance, already appeared in the *Magazine* for February last (p. 81), we think it unnecessary to reprint it here. Mr. Phillips adds, however, the following concluding remarks :—

It would be impossible to form any reliable estimate of the total amount of gold which has hitherto resulted from mining operations in Nova Scotia, as the claims are for the most part worked by private individuals, who are generally indisposed to furnish information either as to their success or failure, and no official returns on the subject have as yet appeared. It is manifest, however, from the characteristics of the localities in which the precious metal has already been discovered, and the great extent of the gold-bearing portions of the province, that there is every reason to anticipate that further and more important results will be developed by the workings and explorations of the present summer, and that ere long Nova Scotia will take an important position among gold-producing countries. The thickness of its auriferous veins is, perhaps, less than those of California and some other countries, but they are, generally speaking, richer in visible gold than the average of those I have seen in any other part of the world. It must also be taken into consideration that Nova Scotia possesses many decided advantages over both California and Australia. Each of these countries is situated at a great distance from Europe, and can only be reached after a long and expensive passage, and, as a natural consequence, wages were for a long time exceedingly high and provisions proportionately dear. Nova Scotia, on the contrary, is within an easy distance both from Europe and the United States of America, and possesses a considerable settled population of intelligent industrious, and sober people, eminently adapted, after a little experience,

to become steady and efficient miners. The whole of the gold-bearing portion of the province also lies within a convenient distance from the coast, which abounds with magnificent harbours, affording ample security to shipping, whilst wood in large quantities is to be everywhere procured for all descriptions of mining uses, and an abundant supply of water is generally to be met with for the purposes of washing and amalgamation. From these circumstances, it is impossible that wages can ever reach the extravagant rates that mainly led to the failure of nearly all the gold mining enterprises of 1852, since which period many of the mines have been advantageously worked which were then abandoned on account of the enormous expenditure necessary to carry on the operations.

Gold of North Wales.—The gold district of North Wales would appear to be chiefly confined to an area of about twenty square miles, lying on the north of the turnpike-road leading from Dolgelly to Barmouth. In this region the Cambrian rocks are overlaid by the Silurian, and the general geological features of the country strongly resemble those of other auriferous localities. The most important discoveries have been made in the Dol-y-frwgnog, Prince of Wales, and the Clogau mines, of which the latter only is at the present time worked with remunerative results. So long ago as 1884 a paper was read before the British Association by Mr. Arthur Dean, who stated that a complete system of auriferous veins exist throughout the whole of the Snowdonian or Lower Silurian formation of North Wales. In consequence of this statement, operations were commenced at Cwmhesian, but, the results obtained not having been found satisfactory, they were finally abandoned. Ten years subsequent to this time the mine was again worked for gold, but still with unfavourable results. Machinery for crushing and amalgamation was about two years afterwards erected at Dol-y-frwgnog, but, after operating on several hundred tons of quartz, the result was in this instance also a failure. Of all the auriferous veins in the neighbourhood of Dolgelly that at present worked in the Clogau Mountain is certainly the most important. This mine is situated at a height of about a thousand feet from the level of the sea, and the workings are extended on what is called the St. David's or Gold lode. This lode, which is almost perpendicular, runs nearly east and west, and is chiefly composed of auriferous quartz, more or less impregnated with sulphides of iron, lead, and copper. The veinstone also exhibits large quantities of disseminated gold, which generally occurs in a state of minute division. This mine is, being worked on a small scale, and by means of very simple and far from perfect machinery. The following returns were, however, made during the course of the year 1861:—Ore crushed, 456 tons 32 lbs.; fine gold obtained, 2,884 ozs. 1 dwt. 7 grs., being at the rate of 6¾ ozs. per ton of quartz operated on. During the current year, up to April 26th, the results have been—Ore crushed, 255 tons 16 cwts. 16 lbs.; fine gold obtained, 1,962 ozs. 2 dwts., or 7⅝ ozs. per ton of quartz. It is needless to add that such a degree of success has given rise to the commencement of numerous mining operations in various parts of the district; but if gold mining in Merionethshire be approached in the speculative spirit that characterized the proceedings of 1852, it requires no prophet to foretel that numerous failures must necessarily be the result.

Methods for Extracting Gold from its Matrix.—The most simple and, at the same time, most ancient method for obtaining gold is undoubtedly by washing the sands and dirt with which it is found associated. Among the earlier miners in California and Australia the "cradle" was much employed. This instrument appears to have been introduced from Virginia and Carolina, and consists of an oblong inclined box, having a sieve at its upper extremity mounted on rockers, so that, by means of a handle, it may be swayed from side to side. The interior of this case is provided with a sloping diaphram of tightly stretched canvas, and the bottom is divided

into partitions by means of wooden cleets. Washing by the cradle is, however, a very slow operation, and requires a great deal of manual labour, since, besides rocking, it is necessary to supply it with water by means of a dipper, and to continually stir the fresh-brought stuff deposited on the sieve. The gold and other heavy bodies retained between these wooden divisions are finally re-washed in a tin pan, and the metal thus obtained in a pure state. The loss of fine gold attending this operation is very great.

The arrangement which next came into general use among Californian miners was the "long tom." This consists of a long, roughly made wooden case, having a considerable inclination, and provided at its lower extremity with a sieve made of perforated sheet iron, beneath which is placed a "riffle-box," divided into compartments, as in the case of the cradle, by means of slips of wood. In the upper trough a stream of water is so directed as to fall with considerable force upon the auriferous drift with which it is charged, and this being continually stirred with a shovel, the finer particles are gradually washed through the sieve over the riffle-box, whilst the coarser fragments are from time to time removed, after being duly examined for any nuggets they may contain. The stuff retained by the riffles is afterwards washed in a pan, and the clean gold is thus separated. The tom has the advantage over the cradle of getting through a much larger amount of work within a given time; but it requires a much more plentiful supply of water, and the loss of fine gold is great.

When convenience exists for its introduction, the "sluice" has now generally superseded the tom. This arrangement is nothing more than a long run of wooden troughs, provided with false bottoms, in which auger-holes have been bored to a certain depth, and in which mercury is generally placed. Through these inclined troughs the "pay dirt" is washed, and the metal, from its greater density, settling in the depressions at the bottom, and combining with the mercury placed there for that purpose, is thus retained. These false bottoms are occasionally removed, and the mercury separated from the gold by filtration and subsequent distillation. This process, although a certain portion of the gold is still lost, is generally much preferred to either of those above described. It is also now customary, whenever a sufficient fall of water can be obtained, to direct a stream, by means either of metallic tubes or canvas hose, against the bench of pay dirt it is intended to remove. A powerful stream playing against the side of a hill will in a short time disintegrate a large quantity of dirt. The rubbish thus detached is conducted through a sluice in the usual way, and the gold is in this manner separated and collected. This method of proceeding is known by the name of "hydraulic mining," and is, generally speaking, considered the most economical that can be adopted. When, instead of being found in deposits of pay dirt, the gold occurs in veins, associated with other metals, it becomes necessary to reduce the gangue to a state of fine division before it can be extracted. Two distinct methods are employed for the separation of this metal from from the matrix with which it is associated—viz., washing and amalgamation.

In some countries, and particularly in Mexico, the "arrastre" is much employed for the treatment of auriferous minerals.* This consists of a vertical axis, provided with cross arms, to which are attached, by means either of ropes or thongs of untanned leather, two or more heavy masses of porphyry. Mules are harnessed to one of the projecting arms, and a rotatory motion given to the shaft. The stones thus set in motion are dragged over a well-paved bed, and thus, by an action somewhat resembling that of the common muller and slab, the ore is gradually

* For a drawing of an arrastre, see Mr. Napier's paper in March Number, p. 168.

reduced. Mercury and water are added to the ores operated on, and the resulting amalgam is from time to time passed to the retort. In some instances the ores are introduced into the arrastre in fragments of about the size of peas; but in large establishments it is first coarsely ground in a stamping mill. It is needless to say that grinding by means of the arrastre is a slow and expensive operation.

In Chilli the "trapiche" is much used. This is nothing more than a grinding-mill, like the ordinary edge runner. The roller runs on a groved bed-stone, in which a certain quantity of mercury is placed, and by the continual trituration of the revolving runner the ore is gradually reduced and amalgamation effected. This is however, like the foregoing, a tedious and costly operation.

In some cases a mill like that commonly employed for grinding corn has been made use of, and found to answer remarkably well. In one establishment where apparatus of both constructions is in operation the ratio of the cost of grinding by the horizontal mill as compared to the edge runners is as 2*s*. 3*d*. to 6*s*. 10*d*. The ordinary roller crushing-mill has also been employed for the reduction of gold quartz previous to amalgamation, but it cannot be considered to be well adapted for this purpose. In the first place, the whole of the stuff coming from the mill has to be passed through sieves of fine wire-gauze, and these become so rapidly worn by the rougher fragments which are being returned to the raff wheel so as to render repairs constantly necessary, and the operation very expensive. Then, again, unless the ore be remarkably dry these sieves choke, and the stuff is carried round and round without passing through; and, finally, if the ore be dry, such a dust is created as to nearly choke those attending to the crusher.

Among the quartz miners of California and Australia the stamping-mill is now the machine almost universally employed. The ore is often first calcined in heaps of kilns, and, after stamping, the reduced mineral is passed through apparatus of various forms for the separation of the gold. The calcination of the quartz, although not always adopted, is frequently productive of advantageous results. Hard quartz is rendered much more friable by this treatment, and when a large proportion of sulphides is present the expulsion of sulphur by the operation of roasting is likewise beneficial. It is also probable that when gold occurs in thin finely-divided laminæ the ignition of the quartz causes such an agglutination of its particles as to cause them to offer less surface to the action of the water, and that the loss of "float gold" is thereby diminished.

The metal is separated from the stamped ore either by washing alone, or by washing and amalgamation. When the former process is resorted to the stuff flowing from the stamping-mill is either allowed to pass over riffle-boxes, or is conducted over blankets, or skins on which the air is retained. These are occasionally washed in proper vessels, and the metal retained by them thus collected. The gold so obtained is, in most instances, concentrated by washing in a "batea" or otherwise, and finally amalgamated, or less, frequently fused with litharge, or an ore of lead, and finally cupelled, When amalgamation is employed, the riffle-boxes may be charged with mercury, or the auriferous sands produced can be passed through triturating apparatus containing mercury, with which the gold is caused to combine. In some cases barrel amalgamation is resorted to. The diagram on the wall exhibits a combination of three of the most efficient amalgamating appliances used by the miners of California and Australia, which is well calculated to separate the precious metal from ordinary gold quartz. The ore flowing from the mill, first passes over a lip through a triturator, not unlike that employed at Zell, in the Tyrol, and then falls into an appartus the action of which is similar to that of the amalgamating barrel. Finally, the whole of the stuff, before passing over riffle-boxes or blankets, is

agitated in a column of mercury, through which it is made to descend. In some instances, where water is not plentiful, that from which the tailings have settled is again pumped round. In this case a little wood ashes should from time to time be thrown into the mill. This is employed for the purpose of saponifying any oil or other fatty matter which, if present in *even the most minute proportions*, when quicksilver is used, would, by preventing the particles of gold from uniting with the mercury, materially interfere with the results obtained. It is, therefore, of great importance in all quartz crushing and amalgamating establishments that proper care be taken to prevent any dropping of oil from the bearings into the apparatus, since the result of such an accident would inevitably be a notable falling off in the the produce of gold obtained. In order to prevent loss occurring through this cause it would, as before stated, be found advantageous to throw from time to time into the mill a little wood ashes, or some other alkaline body, for the purpose of removing any greasy matter which may have become accidently introduced. When the quartz contains an appreciable quantity of auriferous sulphides it would in many cases be found advantageous to separate these from the tailings by means of a Hundt's buddle applied to the end of the riffles. The sulphides thus collected might be treated either by fusion with oxide of lead, and the produce cupelled for gold, or after a preliminary roasting be again subjected to amalgamation. The former process will, however, in many instances prove the most advantageous.

As an instance of the small yield of gold which, even in Australia, is at the present time found remunerative, I would quote the following results of the Colonial and Port Philip Company. It must, however, be observed that, to obtain a satisfactory profit from ores of this class, it is necessary not only that large quantities should be treated, but also that the greatest economy should be observed in every department of the manipulation The quantity of quartz crushed by this company between October 1st, 1860, and September 30th, 1861, was 32,258 tons, from which the produce was 24,336 ozs. 6 dwts., being an average of 15·2 dwts. per ton. The quantity crushed during the preceding year was 21,693 tons, and the produce 17,466 ozs., being an average of 16 dwts. per ton, showing an increase in crushing of 10,563 tons, and on yield of gold of 6,870 ozs. over the same period of the previous year. It will be perceived that the yield of gold per ton had experienced a variation of 22 grs., equal to $5\frac{3}{4}$ per cent. The total expenditure per ton has been 12*s.*; in the preceding year it was 16*s.* The profit on the quartz crushing for the year ending September 30th was 22,958*l.* 16*s.* 5*d.*

Assay of Ores containing Gold.—Minerals containing gold are in most instances assayed in precisely the same way as those affording silver. It may be proper to remark here that although nothing is more easy than to estimate with great accuracy the amount of gold contained in any given specimen of gold quartz, it is considerably more difficult to obtain a fair average sample of the usual produce of a vein. When the metal is in a fine state of division, and equally disseminated throughout the gangue, this presents less difficulty; but when, on the contrary, it occurs in pockets and irregular deposits it frequently requires the exercise of great care in order to avoid falling into very serious errors. It is consequently of the highest importance that whenever ores are to be assayed for gold the greatest care should be observed in preparing the samples on which the operation is to be conducted, of which at least six different assays of 1,000 grains each should be made.

If after accurately testing the produce of a parcel of ore, it be passed through the most efficient crushing and amalgamating machinery with which we are acquainted, it will be found that the total amount of gold originally present in the stuff is never obtained, and if this deficit be

sought for in the tailings resulting from the operation it will be discovered that a certain small quantity of the precious metal still remains unaccounted for. This deficiency would appear to be due to the circumstance of minute particles of flattened gold having floated off on the surface of the water, and frequently amounts to nearly 2 dwts. per ton of ore treated. When the ore to be examined contains silver in addition to gold, and it is desirable to ascertain its amount, it becomes necessary first to cupel the button of lead without the addition of silver; the metallic globule thus obtained is weighed, and its weight noted, deductions being made for the weight of silver derived from the reduced litharge, which must be ascertained by a distinct cupellation. If more silver is required for the operation of parting it is added, and the button, together with the fragment of silver, enveloped in a piece of pure lead foil, and again cupelled. Lastly, the resulting globule is dissolved in nitric acid, and the gold weighed. The weight of silver present in the ore will consequently be represented by that of the button of alloy obtained from the first cupellation, less the united weights of the gold and the silver resulting from the reduced litharge. In concluding this subject I cannot better express the great importance of obtaining fair samples than by quoting the words made use of by Dr. Percy, in a lecture delivered in 1852, at the School of Mines, who, when speaking of good assays, said—"Above every thing be particular in obtaining an honest and fair sample. This is a matter of paramount importance, and of no small difficulty in many cases, but let there be honesty of intention, and this difficulty will be generally surmounted."

Gold Mining Speculations of 1852.—Shortly after the discovery of the gold deposits of California and Australia numerous associations were organized in the United Kingdom for the purpose of working gold mines in those countries, and I regret to say that, in almost every instance these have resulted in the loss of the capital so embarked, various circumstances have contributed to produce these disastrous results, but none more so than the fact that, in too many instances, sufficient attention had not been paid to obtaining samples, fairly representing the average produce of the various veins which it was intended to work. The specimens which reached this country were often picked samples, and on being placed in the hands of the assayer yielded a produce which was far from realized when fair average samples of the leads came to be tested on a large scale. Then, too, it was not unfrequently found that quartz veins, producing what should have been a remunerative amount of the precious metals, were situated in localities in which, either from the want of water or some other cause, their exploitation was attended with extraordinary difficulties. And, above all, the excessive price of labour, and all other mining requisites which then prevailed, was in most cases, a sufficient barrier to any thing like remunerative returns to the proprietary.

In all rich and newly-discovered gold districts, which have for the most part a very limited resident population, the alluvial and easily-worked deposits afford for a considerable time a superabundance of remunerative occupation for the newly-arrived immigrant, but as these gradually but slowly become exhausted, something more than mere muscular strength, becomes necessary in order to keep up the returns, a more systematic method of mining is adopted, a thorough combination of labour and the investment of larger capitals are required. It must, however, be remembered that these changes, although gradual even in a new colony, are infinitely more rapid than those who have always resided in European countries generally imagine. Ten years in the life of a colony, and particularly a gold-bearing one, effect greater changes in its commercial and social relations than a century in an old established country, and we have, consequently, no reason to be astonished that veins are at the present moment being advantageously worked both in Australia and California

when in 1852 such operations would have been attained by a certain and very considerable loss.

It is a generally admitted fact that veins of auriferous quartz have little or no relation, with regard to the expense of working them, with the more readily worked alluvial deposits in their vicinity. In the one case the rock has to be broken, crushed, and washed, at a considerable expenditure of time and money, whilst in the other Nature has for centuries been carrying on these operations, and so preparing the gold as to admit of its extraction by very simple means. It consequently follows that the period at which quartz veins can be advantageously worked in any given locality will not entirely depend on their yield, but will also be more or less influenced by the abundance and richness of the alluvial diggings in the vicinity, and the general price of labour, and materials in the district. The supply, and consequent price of labour must also be materially influenced by the distance at which gold producing countries may be situated from the great centres of civilization. From their remoteness and their consequent difficulty of access, Australia and California for a considerable period offered striking examples of the demand for labour exceeding the supply, but the constantly increasing facilities afforded for travelling, and in some instances their nearer proximity to Europe, will probably prevent this occurring to the same extent in the more recently discovered gold fields. There is, therefore, every reason to believe that the amount of gold annually derived from the working of gold quartz will go on gradually and rapidly increasing; and that, by the introduction of efficient and powerful machinery, ores of a very low produce will ultimately be treated with advantage. These observations particularly apply to the province of Nova Scotia, whose geographical position renders it impossible that labour should ever attain an excessive value, whilst, if a large supply of auriferous quartz can be obtained from the mines of North Wales, it is evident that a very small yield of gold, if continuous, might be rendered remunerative.

The operations of separating oxide of tin from its matrix, and gold from its ores, are, in many respects, exceedingly analogous, and, consequently, the expenses incurred in the one case may (all other circumstances being the same) serve approximately as a guide for estimating the cost which should be incident to the other. The most efficient apparatus employed in this country for the reduction of ores to the requisite degree of fineness are undoubtedly to be found in the tin mines of Cornwall; and as an example of the expense attending the process of stamping, it may be stated that at Polberro Consols, in the year 1854, a 36-in. condensing-engine, working at 55 horse-power, stamped no less than 30,200 tons of tinstuff, at a total expenditure of 1*s.* 3½*d.* per ton. Each head stamped, therefore, 420 tons per annum, or 28 cwts. per 24 hours, whilst the whole number reduced 100 tons per day, at a cost of 2*s.* 4*d.* per horse-power. During the same year the average produce of the stuff stamped was 20¾ lbs. per ton, and the net profit on the operations 2,350*l.* 9*s.* 8*d.* If we now assume the value of black tin to be 8*d.* per lb., and that the expense of stamping an equal quantity of gold quartz would have been the same, the total value of the produce obtained from each ton will be 13*s.* 10*d.*, or equal to a yield of about 3½ dwts. of fine gold. It must, however, be admitted that the cost of stamping a ton of ordinary gold quartz will be somewhat greater than that of treating an equal quantity of Polberro tinstuff, and that when the gold is in an exceedingly minute state of division, or when sulphides are present in large quantities, the separation of the gold may sometimes be attended with a certain amount of difficulty, but this difference will, in many cases, not be material. It is, therefore, evident that when large quantities of auriferous quartz can be obtained, in a country where the price of labour is not high, it is not necessary that it should contain a large amount of the precious metal in order to render its treatment by the aid of well-construc-

ted machinery remunerative. As an instance of the very small yield which, under peculiar circumstances, may be rendered available, I would adduce the fact that at Schemnitz, in Hungary, in the year 1842, the total quantity of ores stamped was above 40,000 tons, and the average of the useful metals extracted from 50 tons was—gold, 3 ozs.; silver derived from the separating process, $3\frac{3}{4}$ lbs.; lead similarly obtained, $8\frac{1}{4}$ cwts.; the ratio of the gold to the other materials being here as one to half-a-million. It is also important to state that in this instance the ores had to be broken from solid lodes, at depths extending to 200 fathoms from the surface.

The Chairman (Mr. Sopwith) in moving the vote of thanks, said that he was sure they would all agree with him as to the great value of Mr. Phillips's paper: he had seldom listened to a paper in which a subject has been more clearly brought forward. For his own part, he considered that the real interest of the subject rested upon the extraction of the gold, which occurred in a state of very minute subdivision, since it was there that we must look for profits. Many of the remarks in Mr. Phillips's paper must be of the greatest possible use both to those supplying funds for the working of gold properties, and to the gold-seekers themselves. He considered that Mr. Phillips had laid the Society under a great obligation to him, and he, therefore, asked them to give him their best thanks. With respect to the peculiar contorted formation referred to by Mr. Phillips, he thought it was highly interesting, and he would, in connection with it remark that in the International Exhibition, in the Belgium department, they would find maps of formations met with in that country where the contortions were even still more remarkable. Mr. Phillips had told them that in a new colony the change effected in ten years was as great as a century would produce in an old country—a statement which he entirely agreed with. To confirm it they need only refer to Australia—the colony of Victoria. In the course of the ten years, since the first nugget was brought over, the improvement had been marvellous. In 1851 the export of gold was 145,146 ozs., the value of which was 580,527*l.*; whilst in 1860 it was 2,156,660 ozs., worth 8,626,642*l.*; the aggregate in the ten years being nearly 24,000,000 ozs., of the value of 95,671,918*l.* This was according to the Customs' returns, but if they added the amount brought over privately, the value would be raised to the enormous amount of 103,971,976*l.*

MINERS' PERMANENT RELIEF FUND.

Since we referred to this subject last month, the decision of the Northern Coal Trade has been received by Miner's Delegates of Northumberland and Durham. This decision, which was communicated by the letter of Mr. Thomas Doubleday, the Secretary, was unfavourable to the scheme suggested—to which seemingly insuperable difficulties were pointed out. All the Committee could suggest, was "a fund in aid"—a proposition, it must be confessed, of rather an indefinite nature. It is much to be regretted that some system of co-operation between masters and men could not be brought about, for its absence leaves room for an agitation which will probably lead to bad feelings on both sides. Among the men, one party seems favourable to a course of independent local action on their own part; but another party seem desirous of acting with the "National Association." If the reports given are correct, the representative of this association, Mr. Towers, who has been located in the Newcastle District, seems to have shown more zeal than discretion. It certainly cannot be the object of some at least of the Committee of this Association to employ funds subscribed for benevolent purposes in a systematic propagation of discord and bad blood between employers and employed: the matter should be approached in no such feeling, for what are the interests of the one are substantially the interests of the other. If the masters looked at

the matter in a purely selfish light, and one merely antagonistic to the workman, they would probably wish for nothing better than such an imprudent and chimerical agitation as Mr. Towers is now engaged in—which, at the best, can only end ridiculously. A national relief fund—embracing the whole kingdom—is evidently beyond the grasp of any organization less than a government department; and we doubt much whether it is a task any government would relish to undertake. If the trustees of this Association, in its present condition, venture to receive the contributions of workmen, on the representation of giving adequate relief in return, all we can say is that they are extremely bold men, and are placing themselves in a position which we fear they will some day find far from agreeable. The funds of working men are not to be trifled with.

While this unprofitable agitation is going on in the North, a meeting of the West Yorkshire coal owners was held at Leeds on the 17th May, at which a very instructive discussion took place. The following preliminary resolutions being passed, a committee was appointed, and the meeting adjourned for a fortnight:—

"That a district association be established, for forming a fund for the support of widows and orphans of miners and others persons who are accidently killed in the prosecution of their labours, at the collieries on the north side of the Lancashire and Yorkshire Railway."

"That the proposed association be styled the West Yorkshire Northern Association, for providing a miners' widows and orphans' fund, the object of which shall be to assist and encourage the miners in raising such a fund."

THE GEOLOGICAL JOURNAL.

The Quarterly Journal of the Geological Society. Edited by the Assistant-Secretary of the Geological Society. No. 70, vol. xviii, part 2. London: Longmans.

THIS number of the *Quarterly Journal* contains matter of particular interest, among which we may specially mention the anniversary address by Professor Huxley, and the paper of our esteemed contributor, Mr. Edward Hull, "On the Distribution of the Carboniferous Strata in Great Britain."

Professor Huxley's address, in clearness of thought and vigour of style, is one of his happiest efforts. The greater part of it bears on matters purely biological, and consequently beyond the scope of our *Magazine*, but a portion of it is devoted to a discussion on the real meaning of the word "contemporaneous," as employed by geologists—a question capable of becoming one of economic importance, particularly in connection with coal deposits. Professor Huxley considers, as many physical geologists have already considered, that Palæontologists have pushed the doctrines of synchronism too far, in dealing with large areas or with completely separated deposits. All that can fairly be said of such deposits—such, for instance, as the lias of England and the lias of Germany—is that they are within the same great epoch; but whether this "great epoch" means a hundred years or a thousand, or a million, or ten million years, the answer of the thoughtful geologist is—I cannot tell.

Mr. Hull's paper, which may to some extent be considered a continuation of the same subject as that treated of in his memoir "On the South-easterly Attenuation of the Lower Secondary Rocks," in the xvi. vol. of the *Quarterly Journal*, is one of the highest economic importance with regard to the probable extent of the carboniferous strata lying under the secondary deposits in Great Britain. We shall give a full abstract of this paper in our next number; but in the meantime we recommend our readers

interested in this matter to refer to the paper itself in the *Quarterly Journal.*

The Miscellaneous division contains two lithological abstracts (with the well-known initials H. C. S.) from M. Delesse's memoir "On the Azote and Organic Matters in the Crust of the Globe," and from Professor Bunsen's memoir "On the Formation of Granite."

Correspondence.

[We need scarcely say that we cannot hold ourselves responsible for the facts or opinions of our correspondents; although we shall make it a point to endeavour to exclude those who are obviously inaccurate or fallacious, as far as is consistent with our wish to encourage the freest discussion.]

CAPTAIN W. VIVIAN ON PRACTICAL MINING.

Dear Sir,—The remarks of Capt. Vivian, in your last Magazine, are I think judicious for the most part. He says truly that the character of the ground, whether on the lode or in a cross-cut, should determine the size of the level; but if the level is to be driven a long way without shaft or winze to ventilate, then for the sake of ventilation the level should be larger than would be required for driving economically only. These principles are recognised and acted upon very generally in the Cornish mines of note, the size of the levels being fixed by the agents on setting the bargain. The men will sometimes, towards the close of the month, contract this size just to get the line of measurement as long as possible, but that is counteracted by the agent.

In this mine, the general size of levels is 8 feet by 6 feet, but sometimes, when the nature of the ground or other circumstances require it, the size is higher or wider, sometimes 7, 8, or 9 feet in width, and sometimes 9 feet high. The object ever kept in view is, *in hard ground*, to *open the mine as fast as possible,* and if Capt. Vivian has not seen our hard ground Cornish mines for the past 10 or 12 years, he cannot form a correct opinion or notion of what is being done in such mines. However, he is worthy of thanks for directing attention to this or any practical question in mining.

Dear Sir, Yours truly,

Dolcoath Mine, Camborne, Charles Thomas.

May 20th, 1862.

Sir,—There occurs two misprints in my letter on "Practical Mining," at page 333, 12th and 16th lines, "clearage" being twice printed for "cleavage."

Pary's Mines, near Bangor, W. Vivian.

May 7th, 1862.

MEXICAN METHOD OF AMALGAMATION.

Sir,—Perhaps you will be kind enough to allow me to correct a few errors which occurred in my papers on the above subject.

Page 172, 7th line from top, for "Are finely ground" read "Ore finely ground," and leave out the hyphens.

Page 172, 4th line from bottom, for "*Asogerros*" read "*Asogueros.*"

Page 174, 12th and 20th lines from top, for "*Dolares*" read "*Dolores*."

Page 231, 10th line from top, for "Fine Amalgam" read "Zinc Amalgam."

Page 233, 5th line from top, after "this" insert "the."

Page 234, 4th line from bottom, for "Saco" read "Tasco."

Page 235, 10th line from top, for "Ensabmorar" read "Ensalmorar."

Page 236, 10th and 29th lines from top, for "Incorparo" read "Incorporo."

Page 238, 26th line from top, for "Where" read "When."

I am, &c.,

JAMES NAPIER, Jun.

[We have received several communications on Captain Vivian's letter, and on other matters, for which we cannot find space this month.]—ED.

Notes and Queries.

THE subject of Furnace *versus* Machine Ventilation has been the topic of discussion amongst scientific men for the past few years, and there are great differences of opinion as to the merits of the rival modes of ventilation. Struve's ventilating machine, which, for ingenuity and skill of construction, redounds to the credit of the inventor, has been adopted in several collieries in the South Wales district, and no fault has been found with its working. At the great Risca inquest, the ventilating machine was the especial subject of attention, and the evidence conclusively proved that it had always worked with the greatest regularity; Mr. Brough, the Government inspector, and several of the mining engineers present, however, gave a decided preference to the furnace for safety and regularity. The limit of the machine was looked upon as objectionable, while, on the other hand, a furnace could be made to draw an unlimited quantity of air. A machine is also liable to breakage, and the natural ventilation that would ensue would be nothing compared with the natural ventilation after a furnace had been put out. The machines at the different collieries have not, it is true, shown any of these defects, but there is a probability that they might do so. Influenced by these considerations, and by the strong recommendation of Mr. Brough, the Government inspector, the managers of the Risca collieries have determined on substituting a furnace for the ventilating machine. This, it is believed, will conduce to the safety of both men and property; and as the black vein is an exceedingly fiery one, it is only proper that every reasonable precaution should be taken against accidents.

We have received a lengthy communication from Mr. John D. Nash, of Variety Hall, Halifax, Nova Scotia, on the mineral resources of that province; but we have not space at present to enter upon the wide field of subjects Mr. Nash refers to.

THE HARTLEY CATASTROPHE AND BRATTICED SHAFTS.—A parliamentary paper has been issued during the month, containing Mr. Kenyon Blackwell's report on the Hartley accident, and also "copies of the replies of the inspectors of mines to the circular letter which was addressed to them, by desire of the Secretary of State for the Home Department, on the subject of shafts." Mr. Blackwell's report is able, suggestive, and moderate, as we might expect from a gentleman of his position. While dwelling upon the immediate causes of the unhappy disaster in question, he avoids that dogmatising of which we have recently heard so much, but which is really only worthy of "sensation" article writers in newspapers, manufacturers of "padding" for popular magazines, trading philanthropists, or fourth-rate

M.P.'s in search of some topic by which they may gain a nine days' notoriety.

The reports and recommendations of the inspectors, which are singularly unanimous, contain many facts and suggestions well worthy of consideration. A little less unanimity—as evidencing a greater amount of independent opinion—would have been perhaps preferable, particularly as the reports were made during a time of popular clamour. We do not say they were influenced by this clamour; but we know how different it is to avoid being affected by such a cry as resounded through England after the Hartley accident.

The following are the recommendations of Mr. Higson, which may be taken as representing the views of nearly the whole of the inspectors:—

1. That the 6th General Rule be so amended as to compel every future working and pumping pit or shaft to be securely cased or lined throughout with iron, brick, or stone.

2. That on and after the 1st January, 1863, proper guides or conductors shall be provided, and used in every pit or shaft in which persons ascend descend; and that at every working pit or shaft there shall be movable or self-adjusting guards or gates to fence off the entrance thereto.

3. That from the workings of every mine there shall be two distinct shafts or outlets, not less than ten yards apart.

4. That mines now opened and being worked with a single bratticed shaft, may be continued for three years, if during that period active operations are in progress to provide a second outlet, and the means of egress therefrom.

5. That for the purpose of exploring or proving the ground, a single bratticed shaft may be used for a period of six months after finding the vein or seam, provided that not more than ten persons shall be in the pit at the same time.

6. That when water has to be pumped in a single bratticed shaft, proper and satisfactory preparations shall be previously made to prevent detached portions of the machinery or other apparatus, in case of breakage, falling into the pit or shaft.

7. That during the time persons employed in working any mine are ascending or descending the pit or shaft, pumping in that pit or shaft shall be suspended.

Mr. Kenyon Blackwell, in his report, points out that all the pumps in the Hartley pit were bucket lifts; and he justly remarks that the use of such lifts are "a source of much danger" when employed exclusively to considerable depths, in connection with powerful engines. We may add that their employment to such an extent is most wasteful, and is indeed an engineering barbarism. If the metallic mines of Cornwall are behindhand in their appliances for raising their mineral produce, they certainly are infinitely in advance of colliery miners in pit-work. Such pit-work arrangements as were in use in the Hartley shaft, and which are largely adopted in still deeper and more extensive collieries, have been exploded in Cornwall for nearly fifty years.

Geological Society of London.—At the meeting of this society, on May 7th, the following papers were read:—

1. "Note respecting the discovery of a new and large Labyrinthodont (*Loxomma Allmani*, Huxley) in the Gilmerton ironstone of the Edinburgh coal-field." By Professor T. H. Huxley, F.R.S., Sec.G.S.

2. "Note on a new Labyrinthodont (*Pholidogaster pisciformis*, Huxley) from the Edinburgh coal-field." By Professor T. H. Huxley, F.R.S., Sec.G.S.

3. "On the Land Flora of the Devonian Period in North Eastern America." By J. W. Dawson, LL.D., F.G.S.

4. "On some Upper Eocene Fossils from the Isle of Wight." By Pro-

fessor Dr. F. Sandberger. In a letter to W. J. Hamilton, Esq., For. Sec. G.S.

At a meeting of the Society on the 21st May, the following papers were read:—

1. "On the Metamorphic Rocks of the Banffshire Coast, the Scarabins, and a portion of East Sutherland." By Professor R. Harkness, F.R.S., F.G.S.

2. "On the Geology of the Gold-fields of Nova Scotia." By the Rev. David Honeyman. (Communicated by the President.)

3. "On some Fossil Crustacea from the Coal Measures and Devonian Rocks of New Brunswick, Nova Scotia, and Cape Breton." By J. W. Salter, Esq., F.G.S., of the Geol. Surv. Great Britain.

4. "On some species of *Eurypterus* and Allied Forms." By J. W. Salter, Esq., F.G.S., &c.

5. "On *Peltocaris*, a new genus of Silurian Crustacea." By J. W. Salter, Esq., F.G.S., &c.

6. "On a Crustacean Track in the Llandeily Flags of Chirbury, Shropshire." By J. W. Salter, Esq., F.G.S., &c.

Mining, Quarrying, and Metallurgical Intelligence.

WALES AND THE BORDERS.

South Wales.—A decided improvement has been manifested in the shipping trade at the various ports during the month, and freights are a trifle tighter. Towards the middle of the month there was a much larger export of iron to foreign ports from Cardiff than for many weeks, if not months past. Almost every ton has been sent to the French, Spanish, and Italian ports, and the chief works in the interior of this district are still busily employed in executing orders which have been received for some time past, and which are almost daily arriving from the Continental ports. With respect to the coal trade there is still an absence of that activity which characterized it a few weeks since, although an improvement is visible. The Vale of Neath Railway Company has almost completed another coal drop in the Swansea South Docks, and there is every reason to believe that the temporary depression in the shipping trade will soon pass away. However, on the whole, considering the dull and unsatisfactory state of trade throughout the country generally, it is surprising that the Aberdare Valley, and the whole of the South Wales district, wears such a gratifying aspect, and that trade should be as buoyant and satisfactory as it is. Wales has not largely participated in the general depression of the country, and at the present time there are symptoms of increasing firmness on the part, of ironmasters, and the orders which continue to arrive from the Continental marts will occupy the various works for some time to come. There are some rather heavy orders still on the books of the principal firms whilst the exports from Cardiff, and the other ports in the British Channel, continue large. The coal trade is not so brisk as during the past two or three weeks, there being but few ships of large tonnage for loading. The traffic returns upon the several railways connecting the ports with the collieries in the interior, show a considerable decrease in receipts, and we fear the returns for the month of May will fall far below that of the corresponding month last year.

Flintshire.—Under the title of the Leeswood Cannel and Gas Coal Company, a limited liability company, with a capital of 100,000*l*., in shares of 2*l*. each, has just been formed. The value of the collieries is so well known that the principal question remaining is the price at which they can

be purchased. The company has acquired the entire interest in the property, including plant, machinery, for 70,000*l*., of which 40,000*l*. will be in paid-up shares, and the remainder by periodical instalments. The collieries are at present in profitable operation, and considerable quantities of very superior Cannel (upwards of 2,500 tons per month) are being raised, and sold at prices which leave a good profit. The coal bears favourable comparison with that of both Torbane and Lesmahago, judging from the reports of Messrs. H. M'Culloch, M.E., T. M. D. Smith, R. D. Webster, and Prof. Fyfe. In this county a new company has been formed for the purpose of working the Gwern-y-mynydd and Cat Hole Mines, near Mold. The estimated capital is 10,000*l*., to be raised by 500 shares of 20*l*. each. Mr. A. T. Roberts, of Mold, is the Solicitor, and Mr. John Roberts, the Secretary *pro. tem.*

MIDLAND COUNTIES.

Derbyshire.—The iron trade of this district (says the *Colliery Guardian*) is in a very unsatisfactory position, and though at first some importance was attached to the greater introduction of iron in the navy, it is now thought that the trade will be confined to a few favoured houses. The inquiry for rails and machinery is increasing. The orders are chiefly for exportation. We have a better inquiry for plates, but the trade is very depressed, and there is great difficulty in obtaining remittances, whilst underselling is going on amongst the makers of inferior brands to a great extent. The coal trade is in a wretched condition, and in some districts there is little if any thing doing. Many of the coal-masters would gladly close their pits, so unremunerative is the trade, if it were not for the misery which it would entail on the workmen and their families. So long as the disastrous war with America continues, there is no hope for any improvement. The mineral products of Derbyshire are well represented at the International Exhibition. Mr. Barrow, of the Stavely Works, shows specimens of Derbyshire coal, ironstone, and iron. The Clay Cross Company exhibit similar productions. Messrs. Fowler and Co., of Sheepbridge Iron Works, show samples of iron from which the armour plates are made.

NORTHERN COUNTIES.

Northumberland and Durham.—The news of fresh Federal successes, brought by the last American mails, continue to impart greater confidence in the various departments of local trade—notably so in the iron manufacture. It is understood that American orders have been received in Staffordshire to a much larger extent than for some time previously, and if this favourable symptom of reviving commerce between the States and Great Britain continue, the Tyne and Wear will participate in the benefit conferred. Already the tone of the local iron market is firm ; the furnaces and factories on the Tyne are improving ; and in Cleveland, parties engaged in the production of iron, are actually busy. Concerning the coal trade there is scarcely any thing to be said. The steam and coking kinds are in tolerably good demand, but other sorts are in only very middling request, and none but the steam collieries are more than moderately busy. Chemicals have undergone no change for about a fortnight, and the trade is dull. Among last week's exports from the Tyne were 50,120 tons of coals, 2,089 tons of coke, 18,087 cwts. iron, and 5,988 cwts. of alkali, being an increase in the shipments of coals of 35,967 tons; coke, 350 tons; alkali, 3,445 cwts.; and a decrease in the shipments of iron of 2,692 cwts. The imports included cargoes of pit props from Drontheim, Libau, Dram, Gothenburg, Saltkallan, and Uddewalda ; pyrites from Stavanger and Levanger : 2,210 bars of iron and 1,920 boxes of scrap iron from Gothenburg ; a cargo of copper ore from Pomaron ; and a cargo of sulphur ore from Rotterdam.

Metal Markets.

THE following weekly reports from Messrs. Von Dadelszen and North, show the position of the metal market during the month:—

April 30th.—There has been a slightly increased demand for metals since our last report, which for the present has arrested a further downward tendency.

COPPER.—The Indian orders for manufactured being still a shade below the price which manufacturers are willing to sell, it prevents any business of magnitude; orders could be placed at 10¼*d.* per lb. The demand for raw is rather slack, at from 94*l.* to 95*l.* for tough cake and ingot. A fair amount of business has been done in Burra, from 94*l.* to 95*l.*; Kapunda, nom. 97*l.*; Chili, 87*l.* to 88*l.* in Liverpool.

TIN has not changed since our last report. English in fair demand at fixed prices. Straits has changed hands to some extent, at 113*l.* cash for home consumption and export. Banca, nothing doing, price quite nom., 124*l.* The Dutch market is flat at 72f. 140,000 slabs arrived towards next annual sale.

TIN PLATES in moderate demand. Some second-hand lots coke have been sold in Liverpool at very low prices. Charcoal move off slowly.

In LEAD there has been more doing, a good deal having been shipped for American orders: prices slightly firmer.

May 7th.—The slight improvement in the metal market which we noticed in our last report has been fairly maintained; still business is much restricted. The moderate prices at which copper, tin, and spelter are now obtainable have as yet not attracted the attention of operators.

IRON.—Welsh bars are in fair request, at 5*l.* to 5*l.* 2*s.* 6*d.* f. o. b. in Wales, and at 5*l.* 17*s.* 6*d.*, delivered f. o. b. here. Good qualities of Staffordshire iron are selling to a fair extent. The fluctuations in Scotch pig iron have been without any material result; after advancing to 53*s.* 9*d.*, the price has dropped again to 53*s.* cash.

COPPER.—Not much business has been done. The limits or very best manufactured are a trifle below smelters' prices, which checks business. Tough cake and ingot 94*l.* to 95*l.* Some business has been done in Burra at 95*l.* Kapunda is held for 97*l.*, which effectually prevents business. Chili, 88*l.*, Liverpool.

TIN.—English unaltered, and in moderate demand. An average amount of business has been done in Straits, at 113*l.* cash, which is our present quotation. A few tons of Banca have changed hands at 122*l.* 10*s.* The Dutch market is dull at 71f. sellers.

TIN PLATES are in stock, but prices are unchanged.

LEAD is decidedly better; an advance of fully 10*s.* per ton having been established, and a large business has been done.

SPELTER.—Business has not been very brisk, but prices are well kept up. The last sales were 50 tons, ex ship here, at 18*l.* 5*s.*; and 50 tons 18*l.* 7*s.* 6*d.*, in warehouse, Hull.

May 14th.—There is a gradual and steady improvement in the metal market. A fair amount of business has been done, but prices have not undergone any change of importance since our last report.

IRON.—Welsh bars are in fair demand, at previous quotations, both f. o. b. Wales and here. Some good orders of Staffordshire here have been taken. Scotch pig iron has fluctuated to the extent of 6*s.* per ton; after touching 53*s.* 9*d.* cash, it has receded to 53*s.* 3*d.* cash.

COPPER quiet, but steady. Many orders for manufactured are below smelters' price, which prevents orders of magnitude. Tough cake and tile are slack. Foreign pretty steady. Burra 95*l.* Kapunda 97*l.* nom. Chili 97*l.* to 98*l.*

TIN in good demand for English, at fixed prices. Straits has sold freely at 113*l.* cash, at which price there are further buyers. Banca nominally 122*l.* The Dutch market dull at 70f. to 70½f.

TIN PLATES in better demand. Charcoal from 27*s.* to 28*s.*, according to quality, in Liverpool. Coke from 20*s.* 6*d.* to 22*s.*

LEAD continues firm, with a fair amount of business.

May 21*st.*—There has been a decided improvement in some branches of the metal trade, while in others, the demand has been very slack, with a drooping tendency in value.

IRON.—Welsh bars are steady and in ordinary demand, some makers ask 5*l.* 2*s.* 6*d.* f. o. b. Wales; but the current quotation is 5*l.* Bars f. o. b. here from 5*l.* 17*s.* 6*d.* to 6*l.* Staffordshire in fair request, at fixed quotations. Scotch pig iron has fluctuated to the extent of 6*d.* per ton; after touching 53*s.* 11*d.* cash, the price has given way to 53*s.* 7½*d.*

COPPER.—For English manufactured, smelters have at last submitted to 10¼, and they are now willing to book orders thereat. Tough cake and ingot at 93*l.* to 94*l.* Burra has been done at 94*l.* 10*s.* to 95*l.* which is the present value. Kapunda held for 96*l.*; Chili, 97*l.* to 98*l.*

TIN.—A good demand for refined and common. A large business has been done in straits, at 115*l.* cash and 115*l.* 10*s.* with full prompt—closing firm at these prices. Banca, 123*l.* nominal. The Dutch market has advanced to 71f.

TIN PLATES have sold to a very fair extent, and the market is stiffening.

LEAD.—A fair demand, and prices well supported.

SPELTER is very quiet; for parcels on the spot, 18*l.* 5*s.* is asked, but a trifle less would not be refused. Special brands in Hull realize 18*l.* 5*s.*, W. H. 18*l.* 15*s.*

Metallic-Ore Markets.

TIN.—The standard for black tin remains unaltered at—

Refined	£102—105
Common	101

There is, however, an improved demand for tin, and as stocks in the hands of consumers are very low, the least favourable turn must lead to an advance.

The West Briton has the following observations on the the position of the trade;—

The stocks of tin in England at the present time are larger than perhaps they ever were before; and this may partly be accounted for by the fact that the monthly produce of the Cornish is larger by 200 tons than usual. We have been accustomed to bring to market monthly from 900 to 1,000 tons, but of late the produce has been 1,200 tons. The present price of tin being lower than it has been for many years, consumers consider it a safe point, and orders are given out more freely.

COPPER.—At the four Cornish sales we give this month, the number of tons, average produce, quantity of fine copper, average price per ton, and standard, have been as follows:—

Date.	*Tons.*	*Produce.*	*Fine Copper.* Tons. cwt.	*Price per ton.*	*Standard.*
Apr. 24.	2,342	6⅛	142 2	£4 17 6	£125 16 0
May 1.	3,550	6⅜	226 12	5 4 0	124 8 0
„ 8.	2,876	6¾	192 9	5 11 0	124 2 0
„ 22.	5,647	6¼	350 10	4 17 0	122 13 0

At the sale of the 24th, according to the *Mining Journal*, there was a decline of 10*s*., while, according to the *West Briton*, there was an advance of 30*s*. At the sale of May 1st, the standard was stationary according to the *West Briton*, but advanced 15*s*. according to the *Mining Journal*. On May 8th it advanced from 20*s*. to 25*s*. At the sale of May 22nd there was a fall of from 3*l*. 10*s*. to 4*l*.

LEAD.—Comparing the lead-ore sales for the month with those of the former month, there appears to be no material alteration.

London Share-Market.

THE improved prospects of several mines has had a most wonderfully favourable effect on the market during the past month, and the amount of business transacted has certainly been the largest that we have had the pleasure of noticing during the last twelve months.

East Caradon, after many fluctuations, closed at 44¾, 5¼; at one period these shares reached the quotation of 47 buyers, again receded to 42 sellers, but closed firm. The report of the mine last issued shows a little improvement on that of the previous week. The lode at the 70-fathom level will be reached, it is expected, early in July next.

East Carn Brea have advanced during the month, and were at one time quoted 20½, declined to 17, but again improved and closed at 19½. The reports on the position and prospects of this mine have been very conflicting for a long time past, and several agents have been commissioned to inspect the property. The results of these inspections are various, some highly favourable, others less so; but one conclusion seems to pervade all, viz.:—*that the mine is opening out well*, and that the reserves are rapidly increasing. The difference of opinion seems to be more immediately connected with the present market price of the shares, but the same opinions may as justly and do exist in regard to many other mines, some of which may be considered by a few to be selling at a very *low* figure, whilst other parties may be found who would as unhesitatingly pronounce the same property to be selling at rather a *high* rate. These contrary opinions arise from the difference in the amount of *perspective* value placed upon certain undertakings by various parties.

Clifford Amalgamated have been rather more dealt in, but closed lower.

East Grenville has advanced to 3 buyers, and the mine is said to be looking well.

Gonamena Shares have been inquired for, and some transactions have taken place.

Great South Tolgus largely dealt in at improved prices.

Great Fortune very steady and firm, and have been largely absorbed by investors. The mine is progressing very favourably.

Herodsfoot have risen to 41 buyers, and are generally scarce in the market.

Hingston Downs more inquiry at high prices.

Marke Valley have gradually receded to 9½ sellers.

New Seton much sought after, but very few shares came on the market. The mine is opening out well.

North Downs have been extensively dealt in at various prices, they closed lower.

North Trelawney have been subject to fluctuations, but closed firm at 28-30.

North Basset is again attracting attention. The sinking of Grace's shaft has been resumed, and the lode found to be worth, at present, 4 tons per fathom.

North Treskerby, numerous transactions at much advanced prices.

North Phœnix, several dealings at quotations varying between 7 and 9.

Providence, very firm and steady at former quotations.

South Carn Brea 3½-4, with a fair demand.

South Caradon, very scarce in the market, the shares being taken for investment.

South Frances have risen considerably during the last few days, and closed 115-17½.

St. Ives Consols occasionally dealt in.

Stray Park shares have improved, and many shares have changed hands.

Tincroft has received considerable attention lately and closed firm at 11½-12.

West Caradon, not very much business doing, they closed 34-36.

West Rose Down, very steady, 15-17.

Wheal Pollard have been quiet for some days past at 9*s*. to 10*s*.

Wheal Edward, only moderately dealt in at 1¼-½.

Wheal Harriett, steady 1-¼.

Wheal Grenville have been largely dealt in, and advanced to 7½. The reports from the mine are favourable at present.

Wheal Uny have been greatly in demand, and closed 9-½.

Wheal Ludcott, a very large amount of business has been done in these shares at various prices, they closed 9-¼.

Wheal Margaret remain very quiet at 43-45.

Wheal Mary Ann were in demand at 15½-16, but again receded.

Wheal Seton, a good business doing. The latest quotations will be found in the following closing list of prices.

Saturday, 31*st May*, 1862, 2 P.M.

The following are the closing prices furnished by Messrs. Webb and Geach:—

Camborne Vean, 1⅞ to 2⅛; Cook's Kitchen, 29 to 30; East Basset, 41 to 43; East Caradon, 44¾ to 45¼; East Carn Brea, 19¼ to 19¾; Gonamena, 1 to 1½; Great Fortune, 25 to 26; Herodsfoot, 41 to 42; Hingston Down, 3 to 3¼; Marke Valley, 9¼ to 9½; New Seton, 95 to 105; North Downs, 3¾ to 4; North Basset, 5¼ to 5½; North Treskerby, 32½ to 33½; South Caradon, 340 to 345; South Frances, 110 to 115; Stray Park, 34 to 36; Tolvadden 2½ to 3; West Caradon, 34 to 36; West Rose Down, 15 to 17; Wheal Clifford, 27 to 29; Wheal Grenville, 7¼ to 7½; Wheal Ludcott, 8⅞ to 9⅛; Wheal Margaret, 42 to 44; Wheal Seton, 129 to 131; Wheal Uny, 9 to 9½. East Caradon very strong, at an advance. Camborne Vean flat. Cook's Kitchen dull. Sellers of East Basset. East Carn Brea very strong. Grenvilles weaker in character. Ludcotts maintain their price.

South Frances in great request. Sellers of Pollards at 9/6. Gonemena quiet. Hingston Downs very firm. North Downs flat. Inquiries for North Basset.—*Foreign Mines*: St. John Del Rey, 58 to 60; United Mexican, 6¾ to 7¼; Great Northern 10/ to 12/; Port Phillip, 18⅛ to 18¼; Santa Barbara, ⅜ to ⅞ prem.

Provincial Share Markets.

DUBLIN.—The following report is condensed from the *Mining Journal*:—Towards the end of April the general holidays allowed of no large amount of business. The few transactions which took place were chiefly in Mining Company of Ireland and Wicklow Copper shares; the former touched 17*l.* 10*s.*, but receded to 17*s.* 2*s.* 6*d.*, freely taken at 17*l.*; the Wicklow Copper Mining Company's shares moved back to 46*l.*, at which price they were in request. A few transactions took place in Carysfort shares, last call, or 20*s.* paid, at 19*s.*, or 5 per cent. discount. Connorree shares, were ineffectually offered at 32*s.* In General Mining Company for Ireland shares no business was noted. At the Wicklow Copper Mining Company ordinary half-yearly general meeting, on April 23rd, the directors' reports and accounts, made up to March 1st last, were laid before the shareholders.

In the beginning of May business in Mining shares was very brisk, except in Connorrees, which, therefore, fluctuated but slightly, and on sale at 32*s.* 6*d.* Great efforts were made to keep Carysfort shares in good odour pending the call of 5*s.*, payable on the 15th instant, and a kindly appearance in Ballintemple lead mine favoured the desire to keep them in good demand. Transactions, not officially noted, variously stated at 22*s.* to 24*s.* (20*s.* paid), but quotations ranged from 20*s.* to 22*s.*, sellers. Fully paid-up shares (50*s.*) changed hands at 35*s.* General Mining Company for Ireland shares improved; business was done at 4*l.* 12*s.* 6*d.* to 4*l.* 15*s.*, firm. Mining Company of Ireland shares were down to 16*l.* 10*s.*, but recovered, and left off at 17*l.* 2*s.* 6*d.* to 17*l.* 5*s.*, buyers. Wicklow Copper Company shares, 45*l.* 10*s.*, 45*l.* 15*s.* to 46*l.*

Further on in the month business not quite so brisk, but prices well sustained. Mining Company of Ireland shares ranged between 17*l.* and 17*l.* 5*s.*, and freely taken at 17*l.* 2*s.* 6*d.* Wicklow Copper shares firmer, and not to be had under 47*l.*, being an advance of fully 25*s.* per share on last price. Carysfort shares weak at 21*s.*, 20*s.* paid. Connorree shares receded to 31*s.*, and were on sale at that price. General Mining Company for Ireland shares rose gradually to 5*l.* 7*s.* 6*d.*, but flat.

Later in the month business rather slack. The greater portion of the few transactions which took place were done in Mining Company of Ireland shares, which remained in demand at last quotation, of 17*l.* 2*s.* 6*d.* to 17*l.* 5*s.* Wicklow Copper shares further advanced, from 47*l.* to 48*l.*, and in request. General Mining Company for Ireland shares from 5*l.* 7*s.* 6*d.*, flat, to 4*l.* 10*s.* Connorree shares on sale at 30*s.* 6*d.*, and Carysfoot weak at par (20*s.* paid).

Towards the end of the month in mines very little was done, nevertheless prices fluctuated but little. Mining Company of Ireland shares reached at one time 17*l.* 10*s.*, or 5*s.* advance on last price, but have receded to 17*l.* 5*s.*, firm, both for cash and for account. Wicklow Copper shares in demand at 47*l.* 10*s.* buyers, holding out for 48*l.* The recent American news would, no doubt, have caused an immediate improvement in these shares were it not for the temporary general dulness in our money market. Connorree shares have further declined, and on sale at 30*s.* Carysfort shares have changed hands at 20*s.* 6*d.*, and firm. General Mining Company for Ireland shares were freely offered at the recent reduction, but no transactions quoted.

Tabular Abstract of Mining Accounts for the Month.

Date of Meeting.	Name of Mine, and Number of Shares.	Balances. Debit.	Balances. Credit.	Calls. Per Share.	Calls. Total.	Dividends. Per Share.	Dividends. Total.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
	CORNISH AND DEVON MINES.						
April 21	West Wheal Jane (10,000) ...	784 8 4	...	...	...	...	...
" 22	New Birch Tor and Vitifer (6,000)	...	59 5 2	...	...	...	...
" 23	Wheal Sidney (4,096)	2,050 6 8½	...	0 5 0	1,024 0 0	...	...
" 25	West Condurrow (1,216) ...	...	165 0 4	...	...	...	...
" 28	East Pool (128)	...	341 19 11	...	...	2 10 0	320 0 0
" 29	Pendeen Consols (5,000) ...	...	836 19 5	...	...	...	...
" 29	Wheal Arthur (5,990)	283 8 0	...	0 2 0	599 0 0	...	...
" 30	South Condurrow (6,138) ...	34 16 9	...	0 2 0	613 16 0	...	...
" 30	New Crow Hill (6,400)... ...	...	...	0 1 0	320 0 0	...	...
" 30	South Caradon Whl. Hooper (4,096)	44 10 5	...	0 4 0	819 4 0	...	...
" 30	Great Wheal Fortune (1,798) ...	...	1,571 3 11	...	...	0 10 0	899 0 0
" 30	East Margaret (1,024)	785 0 0	...	0 15 0	768 0 0	...	...
May 2	Pedn-an-drea (8,465)	...	...	0 2 0	846 10 0	...	...
" 5	South Frances (496)	...	2,562 4 11	...	...	1 0 0	496 0 0
" 6	North Treskerby (848)... ...	95 3 4	...	...	...	...	...
" 6	West Par Consols (25,000) ...	1,375 12 1	...	0 1 0	1,250 0 0	...	...
" 6	East Grenville (6,000)	699 3 9	...	0 2 6	750 0 0	...	...
" 6	Grambler and St. Aubyn (486)	358 16 4	...	1 0 0	486 0 0	...	...
" 7	Gurlyn (4,910)	150 19 8	...	...	...	...	...
" 8	Calvadnack (915)	891 0 0	...	1 0 0	915 0 0	...	...
" 9	Cook's Kitchen (2,450)... ...	...	899 9 7	...	...	0 7 0	857 10 0
" 9	Yarner (3,097)	668 2 8	...	...	...	...	...
" 9	St. Day United (20,000) ...	12,007 0 0	...	0 8 0	8,000 0 0	...	...
" 9	New Wheal Vaddon (2,500) ...	100 10 1	...	0 2 0	250 0 0	...	...
" 9	West Tolvaddon (5,120) ...	...	...	0 3 0	768 0 0	...	...
" 12	Rosewarne United (512) ...	1,318 11 0	...	2 11 6	1,318 8 0	...	...
" 13	North Roskear (700)	162 7 7	...	...	...	...	...
" 13	Unity Consols (6,000)	847 11 4	...	0 3 0	900 0 0	...	...
" 13	North Phœnix (4,000)	...	151 13 9	0 3 0	600 0 0	...	...
" 13	Frank Mills (5,000)	...	1,478 5 2	...	...	...	...
" 14	North Downs (6,000)	...	1,464 0 0	...	...	0 2 6	750 0 0
" 14	Garlidna United (1,024) ...	804 9 0	...	0 16 0	819 4 0	...	...
" 14	Bampfylde (10,000)	...	203 12 5	...	...	...	...
" 14	Wheal Sithney Carnmeal (2048)	2,127 11 4	...	1 0 10	2,133 6 8	...	...
" 15	Devon Great Consols (1,024) ...	...	...	...	...	8 0 0	8,192 0 0
" 15	East Rosewarne (5,000) ...	102 14 1	...	0 1 0	250 0 0	...	...
" 16	Wheal Owles (80)	...	1,671 4 10	...	...	...	...
" 19	North Buller (1,024)	201 0 1	...	0 10 0	512 0 0	...	...
" 19	Great Caradon (4,096)	87 10 4	...	0 2 0	409 12 0	...	...
" 19	West-Damsel (256)	...	477 18 0	...	...	...	...
" 19	South Crofty (1,105)	...	...	1 10 0	1,657 10 0	...	...
" 19	Emily Henrietta (1,024) ...	...	...	0 10 0	512 0 0	...	...
" 20	Wheal Trelawney (1,040) ...	...	1,990 18 10	...	...	0 12 6	600 0 0
" 20	Wheal Buller (256)	...	789 13 11	...	...	...	...
" 20	Wheal Grenville (5,844) ...	681 2 8	...	...	...	...	...
" 20	St. Ives' Consols (940)	...	...	...	...	0 10 0	470 0 0
	WELSH MINES.						
April 26	South Minera (4,000)	...	...	0 10 0	2,000 0 0	...	...
" 29	Brynford Hall (200)	8 6 1	...	1 0 0	200 0 0	...	...
" 29	Herward United (200)	297 13 3	...	0 10 0	100 0 0	...	...
" 29	Minera (1,800)	...	...	...	...	5 0 0	9,000 0 0
" 30	Cwm-erfin (867)...	...	...	...	...	0 10 0	433 10 0
" 30	Central Minera (2,500)... ...	...	...	0 2 0	250 0 0	...	...
May 5	North Hafod (6,000)	...	...	0 5 0	1,500 0 0	...	...
" 6	Cefn Cilcen (2,500)	...	...	0 2 0	250 0 0	...	...
" 16	Deep Level (2,000)	...	146 0 0	...	...	...	...

Prices Current of Metals.

From Messrs. James and Shakspeare's, 10, Austin Friars, E.C.

			Per Ton.		
IRON	Bars	in Wales	£5 0 0	@	£5 5 0
	„	„ Liverpool	....		5 15 0
	„	„ London	6 0 0	„	6 5 0
	Nail Rods	„ Wales	5 12 6	„	5 15 0
	„	„ Liverpool	6 10 0	„	7 0 0
	„	„ London	6 15 0	„	7 0 0
	Hoops (Staffordshire)	„ Liverpool	7 15 0	„	8 0 0
	„ „	„ London	8 5 0	„	8 10 0
	Sheets „	„ Liverpool	8 10 0	„	9 5 0
	„ „	„ London	9 0 0	„	9 10 0
	Bars „	„ Liverpool	6 15 0	„	7 0 0
	„ „	„ London	7 2 6	„	7 5 0
	Scotch Pig (No. 1. g.m.b.)	the Clyde	2 14 0	„	2 15 0
	Rails	in Wales	5 10 0	„	5 15 0
	Russian	C.C.N.D.	....		....
	Swedish—Hammered—large sizes		....		11 0 0
	„ „	Indian sizes	11 5 0	„	11 10 0
STEEL	Hammered—faggot		....		16 0 0
	„ in kegs ½ and ⅝ in.		....		15 0 0
COPPER	Australian and other *fine* Foreign		....		95 0 0
	Foreign Slab, for Prod. 96 per Cent.		....		84 0 0
	English Tile and Tough		92 0 0	„	93 0 0
	„ Best selected		95 0 0	„	96 0 0
			Per lb.		
	„ Sheets, Sheathing and Rod		10¼*d.*	„	10½*d.*
	„ Flat Bottoms		10¾*d.*	„	11*d.*
YELLOW METAL	Sheets, Sheathing and Rod		8¼*d.*	„	9*d.*
			Per Cwt.		
TIN English	Common Blocks and Ingots		....		114*s.*
	„ Bars (in barrels)		....		115*s.*
	Refined		....		119*s.*
Foreign	Straits		114*s.*		115*s.*
	Banca		....		120*s.*
			Per Box.		
TIN PLATES at Liverpool 6*d.* Less	Charcoal IC, best		28*s.*	„	29*s.*
	„ IX „		34*s.*	„	35*s.*
	Coke IC		21*s.* 6*d.*	„	23*s.* 6*d.*
	„ IX		27*s.* 6*d.*	„	29*s.* 6*d.*
			Per Ton.		
LEAD	Sheet		....		20 15 0
	Pig—W.B.		....		21 10 0
	„ Ordinary brands		....		20 15 0
	„ Foreign, soft		....		19 15 0
	Red		....		21 10 0
	Shot		....		22 10 0
	Dry White		....		27 0 0
SPELTER	(Cake)		18 0 0		18 5 0
ZINC	(Sheet)		....		23 10 0
			Per Bottle.		
QUICKSILVER	(in bottles containing 75lbs. each)		....		7 0 0
			Per Ton.		
REGULUS OF ANTIMONY, French			....		45 0 0

COPPER.—Yesterday Smelters reduced the previous nominal price of 11d. for ordinary sheets to 10½d., and other sorts in proportion, but export orders can still be executed at 10¼d.

YELLOW METAL continues unaltered, but we expect that this move in Copper will induce the makers who have been quoting 9d. to make some reduction.

LEAD is in very good demand, and quotations well supported.

Copper Ores.

Sampled April 9, and sold at Tabb's Hotel, Redruth, April 24.

Mines.	Tons.	Purchasers.	Price.		
Great Wheal Busy......	97	10	£3	3	6
	63	9	3	14	0
	59	11	2	4	0
	58	11	2	9	0
	56	9	2	14	0
	50	10	2	6	6
	40	8	3	12	0
	38	3, 8, 14	1	17	0
	26	11	1	7	0
	20	8	7	5	0
South Caradon	87	8	5	9	0
	85	4	5	8	0
	81	9	8	17	0
	69	2, 7	17	3	6
	46	8	8	15	0
	39	2, 3	19	3	6
	32	4	6	2	0
West Damsel	74	2, 7, 10	4	7	6
	63	3	2	15	6
	60	8	5	3	0
	57	3	1	7	0
	55	10	3	11	0
	44	4, 7, 10	5	1	6
Tywarnhaile	64	4	3	14	6
	51	14	2	11	6
	49	4	2	17	6
Tywarnhaile	48	14	£2	14	6
	38	4	2	9	0
Clifford Amalgam.	58	7	4	9	6
	56	8	4	5	0
	52	8	2	13	6
	26	8	2	1	0
	23	2	3	4	6
	20	2	0	15	0
Craddock Moor	49	2, 7	7	12	6
	47	2, 7	8	8	6
	35	2, 7	5	12	6
Wheal Polmear	50	6	3	16	6
	40	2, 7	4	10	6
	28	2, 3, 4	9	10	6
South Crinnis	49	6	3	10	6
	48	6	2	16	6
North Grambler	47	7	4	11	6
	43	3	5	14	6
Grambler and St. Abuyn	36	8	6	3	6
Cuddra	30	10	2	11	0
Wheal Damsel............	30	9	4	15	6
Creegbrawse	10	6	3	0	0
	3	4	12	14	6
East Tolgus	12	8	3	8	6
New South Ellen	8	2	7	12	6
Wheal Kitty	4	2	7	6	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Great Wheal Busy	506	£1,472	2	6
South Caradon	439	4,180	12	0
West Damsel	353	1,303	1	6
Tywarnhaile	250	733	4	6
Clifford Amalgam	235	779	2	6
Carddock Moor	131	966	9	6
Wheal Polmear	118	638	19	0
South Crinnis	97	308	6	6
North Grambler	90	£461	4	0
Grambler and St. Aubyn	36	222	6	0
Cuddra	30	76	10	0
Wheal Damsel......................	20	95	10	0
Creegbrawse	13	68	3	0
East Tolgus	12	41	2	6
New South Ellen	8	61	0	0
Wheal Kitty	4	29	6	0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.		
1	Mines Royal..................	—	——		
2	Vivian and Sons............	228½	£1,916	9	7
3	Freeman and Co.	204½	984	3	11
4	Grenfell and Sons	295	1,328	1	8
5	Crown Copper Co..........	40½	159	14	3
6	Sims, Willyams & Co. ...	157	529	11	6
7	Williams, Foster & Co....	264⅝	1,823	4	0
8	Mason and Elkington ...	447⅝	2,191	17	8
9	Bankart and Sons	219	£1,193	19	0
10	Copper Miners' Co.	271½	878	6	6
11	Charles Lambert	143	307	0	0
12	Newton, Keates & Co...	—	——		
13	Alkali Co.	—	——		
14	Sweetland and Co.	111⅝	284	5	8
	Total	2342	£11,436	19	6

Average Produce, 6¼
Quantity of Fine Copper, 142 tons 2 cwt.

Average Standard £125 16 0
Average Price per ton........... £4 17 6

Copper Ores.

Sampled April 16, and sold at Tyack's Hotel, Camborne, May 1.

Mines.	Tons.	Purchasers.	Price.
Clifford Amalgamated	101	4, 7	£5 5 0
	100	2	5 18 6
	95	8	5 5 0
	94	11	3 3 6
	92	7	5 13 6
	89	7	5 13 6
	70	3	5 6 0
	66	3	4 3 6
	44	4	3 6 6
Fowey Consols	76	11	5 6 0
	73	2	6 10 6
	70	8	6 5 6
	66	2, 6	1 9 0
	63	10	5 10 0
	56	6	6 9 6
West Seaton	86	4	8 13 0
	67	11	2 8 0
	66	8	4 14 0
	61	4	5 14 6
	58	4	7 13 6
	44	3	5 2 6
	18	11	1 10 0
South Tolgus	77	6	5 6 0
	76	10	3 17 0
	54	4	8 5 0
	50	4, 7	7 15 6
	30	8	5 9 0
Condurrow	102	3, 7	3 5 0
	98	8	2 11 0
	10	6	6 17 0
Wheal Basset	69	2	6 7 6
	63	2, 6	6 10 0
	47	7	6 15 0
	27	2	7 16 6
Wheal Seton	41	8, 11	1 6 6
	21	8	4 17 0
Whl. Seton (Pendarves)	83	7	£4 15 0
	44	7	7 11 0
	13	4	14 9 0
South Frances	66	9	5 13 6
	42	8, 11	3 7 6
	29	10	7 14 0
	28	8	6 6 6
	9	10	4 1 0
East Pool	82	6	4 18 6
	75	3, 7	4 14 6
East Basset	61	8	7 0 0
	43	11	4 12 6
	31	8	5 19 6
	18	10	9 2 0
North Roskear............	31	4	8 10 6
	19	11	2 5 0
(Basset)	49	4	4 5 6
(Pendarves)	38	4	4 3 0
Tolcarne	39	11	4 0 6
	38	2, 8, 11	3 12 6
North Crofty	74	2, 8, 10	3 13 6
West Stray Park.........	71	7	6 17 0
Wheal Grenville.........	33	6	7 1 6
	25	2, 10	4 15 6
	7	2, 10	3 0 0
	1	6	29 2 0
Tresavean	48	11	2 2 6
	12	2, 8, 14	2 10 6
Wheal Harriett	30	8	10 11 6
	20	8	2 4 0
Pembroke	20	11	0 10 6
East Grenville	19	11	2 16 0
Emily Henrietta.........	9	10	7 1 6
	6	10	2 11 0
Great Crinnis	14	9	3 1 0
East Trefusis	3	2, 4	5 5 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
Clifford Amalgam	751	£3,739 19 6
Fowey Consols	404	2,123 3 6
West Seton	400	2,261 15 6
South Tolgus	287	1,698 9 0
Condurrow	210	649 18 0
Wheal Basset	206	1,377 18 0
Wheal Seton	202	1,070 9 6
South Frances.....................	174	953 3 0
East Pool............................	157	758 4 6
East Basset	153	974 18 0
Tolcarne	77	294 14 6
North Crofty	74	£271 19 0
North Roskear	137	674 4 0
West Stray Park..................	71	486 7 0
Wheal Grenville..................	66	402 19 0
Tresavean	60	132 6 0
Wheal Harriett	50	361 5 0
Pembroke	20	10 10 0
East Grenville....................	19	53 4 0
Emily Henrietta..................	15	78 19 6
Great Crinnis	14	42 14 0
East Trefusis	3	15 15 0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.
1 Mines Royal................. ..	—	——
2 Vivian and Sons......	392¼	£2,197 6 1
3 Freeman and Co.	268¾	1,214 19 9
4 Grenfell and Sons	511	3,416 15 0
5 Crown Copper Co.		
6 Sims, Willyams & Co. ...	323¼	1,758 4 6
7 Williams, Foster & Co. ...	590	3,359 13 3
8 Mason and Elkington ...	632¾	3,158 14 7
9 Bankart and Sons	80	£417 5 0
10 Copper Miners' Co.	250¾	1,302 9 3
11 Charles Lambert	497	1,597 6 1
12 Newton, Keats & Co. ...	—	——
13 Alkali Co.	—	——
14 Sweetland and Co.	4	10 2 0
Total	3550	£18,432 15 6

Average Produce, 6⅜.
Quantity of Fine Copper, 226 tons 12 cwts.

Average Standard £124 8 0
Average price per ton 5 4 0

Copper Ores.

Sampled April 23, and sold at Tabb's Hotel, Redruth, May 8.

Mines.	Tons.	Purchasers.	Price.
West Wheal Basset ...	68	10	£3 17 0
	65	7	4 12 6
	57	7	6 1 0
	51	7, 9	6 5 0
	48	5	4 10 0
	41	9	6 17 6
	34	6, 10	5 7 6
	24	9	7 8 6
	23	5, 9	8 8 0
	21	5	10 5 0
	20	7	14 10 0
East Carn Brea	97	9	8 8 6
	68	9	3 16 0
	64	9	3 10 6
	56	9	3 6 0
	48	9	3 19 6
	37	2	11 14 0
	10	9	7 6 6
Par Consols................	82	1, 3, 6	8 9 6
	80	8	6 6 6
	79	8	7 14 6
	28	3	4 8 0
Alfred Consols	57	1	3 18 6
	50	1	2 7 0
	44	7	0 19 0
	40	1, 7	4 4 6
	37	2, 3	1 11 6
	36	3	11 18 6
Levant......................	85	12	1 13 6
	65	7	6 1 0
	55	2	9 2 6
	50	7	6 8 0
	2	6	11 11 0
Copper Hill	65	5	1 16 0
	50	1	3 13 6
	49	1, 5	2 17 0
Copper Hill	41	5	6 4 0
Wheal Margery	66	1, 5	7 15 0
	65	5	2 15 0
	62	1	2 12 6
	5	5	14 2 0
Tolvadden	43	2, 7	3 12 6
	39	2	3 0 6
	39	7	4 17 0
	21	7	10 16 6
	4	1	24 10 0
East Alfred Consols ...	78	5	3 19 0
	41	6	3 18 6
	23	5	5 1 0
Wheal Agar...............	46	6	6 4 6
	43	5	12 5 0
	41	6	6 13 6
Wheal Buller	70	2	3 19 6
	25	1	0 6 0
	24	6	11 7 6
East Rosewarne	26	3	5 11 0
	24	2	11 16 0
	12	3	8 14 0
	11	3	3 12 6
North Basset	37	1, 10	3 10 6
	30	7	5 1 0
South Crenver	48	1	2 5 6
	16	1	7 4 6
West Wheal Trevelyan	30	1	8 3 6
Rosewarne Consols......	20	3	10 9 0
	6	1	28 0 0
Boscaswell	24	1	9 3 6
St. Austell Consols......	17	2, 5	3 17 0
West Tolvadden	8	12	2 6 6
Great North Tolnus ...	5	3	2 10 6
Wills' Ore..................	2	5	3 6 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.
West Basset.........................	452	£2,783 6 0
East Carn Brea	380	2,182 19 6
Par Consols..........................	269	1,934 12 6
Alfred Consols.....................	264	1,039 12 0
Levant	257	1,380 12 0
Copper Hill	205	694 12 0
Wheal Margery	198	923 10 0
Tolvadden	144	778 12 6
East Alfred Consols	142	585 3 6
Wheal Agar.........................	130	1,086 15 6
Wheal Buller	119	558 15 0
East Rosewarne	73	£571 15 7
North Basset	67	281 18 6
South Crenver.....................	64	224 16 0
West Trevelyan	30	245 5 0
Rosewarne Consols	26	377 0 0
Boscaswell	24	220 4 0
St. Austell Consols...............	17	65 9 0
West Tolvadden	8	18 12 0
Great North Tolgus	5	12 12 6
Wills' Ore...........................	2	6 12 0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.
1	Vivian and Sons	450⅛	£2,860 5 9
2	Freeman and Co	218⅜	1,252 2 6
3	Grenfell and Sons	183⅞	1,323 9 9
4	Crown Copper Co..........	—	—
5	Sims, Willyams, & Co. ...	468⅛	2,464 4 0
6	Williams, Foster & Co....	191⅛	1,340 1 6
7	Mason and Elkington ...	456	2,570 12 3
8	Bankart and Sons	159	£1,116 5 6
9	Copper Miners' Co.	445	2,466 2 6
10	Charles Lambert	103⅜	418 7 9
11	Newton, Keates & Co.	—	—
12	Sweetland and Co.	93	160 19 6
	Total..................	2876	£15,972 11 0

Average Produce, 6⅞.
Quantity of Fine Copper, 192 tons 9 cwt.

Average standard £124 2 0
Average Price per ton 5 11 0

Copper Ores.

Sampled May 7, and sold at the Royal Hotel, Truro, May 22.

Mines.	Tons.	Purchasers.	Price.		
Devon Great Consols	106	3	£9	10	0
	104	8	4	6	6
	102	1, 3	4	5	6
	97	3	4	14	0
	94	10	3	19	6
	93	7	3	18	0
	91	5	4	4	0
	89	2	4	5	0
	88	2	4	16	6
	86	6, 9	4	10	0
	79	5	8	14	0
	77	7	8	8	0
	75	6	8	17	6
	72	6	3	17	0
	70	1, 5	3	5	6
	69	1, 5, 10	2	16	0
	68	5	10	3	0
	65	1, 6	3	13	6
	64	6	3	14	6
	61	1	8	17	6
	60	5	5	7	0
	51	6	5	15	6
	49	1	11	3	6
	26	3	8	10	6
	24	9	4	9	6
	23	3	7	0	0
East Caradon	97	5	4	13	0
	96	5, 12	5	13	6
	95	5	5	2	6
	69	5	7	19	0
	55	1	7	1	6
	33	5	10	13	0
Phœnix Mines	107	3	5	6	6
	88	1	3	0	6
	75	3	4	2	0
	60	3	10	3	6
	58	2	4	17	6
Marke Valley	104	6	3	8	6
	101	6	3	5	0
	80	12	3	13	6
	57	8	4	17	6
	41	10	2	14	6
Hingston Down	73	7, 9	£3	6	6
	64	7, 9	4	11	0
	63	9	4	7	0
	60	9	3	0	6
	54	9	2	10	6
	46	3	6	18	0
Great Wheal Martha	109	10	1	9	6
	65	10	2	3	6
	61	1	3	0	6
	21	1	5	8	6
Holmbush	85	12	3	8	6
	68	2	10	8	6
	61	1, 6	10	11	0
	50	7	6	16	0
Lady Bertha	104	6, 10	1	19	6
	100	7, 10	2	12	6
	26	3, 6	6	5	6
Bedford United	109	8	4	7	6
	99	8	4	5	6
East Russell	69	5	2	16	0
	68	1, 6	3	0	6
	49	1, 6	7	15	6
South Bedford	103	10	2	1	0
	54	8	4	15	6
Wheal Friendship	90	2, 6	3	7	0
	54	2, 6	10	2	6
Yarner	131	12	2	16	6
Wheal Emma	47	9	4	6	6
	42	8	7	5	0
	41	12	2	0	0
Kelly Bray	72	7	3	7	0
	50	3, 7	1	5	6
Gunnis Lake (Clitters)	71	3, 7	5	2	0
	48	6	6	7	0
Okel Tor	70	12	2	12	6
	10	6	3	18	6
Brookwood	48	1, 2	4	10	6
	2	9	18	2	6
Gawton	36	7	3	11	6
Fursdon	34	5	5	13	6
Hawkmoor	30	6	4	16	6

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Devon Great Cons.	1,883	£10,718	10	6
East Caradon	445	2.771	17	0
Phœnix Mines	388	2,036	14	6
Marke Valley	393	1,368	1	0
Hingston Down	360	1,443	4	6
Great Wheal Martha	267	630	16	6
Holmbush	164	1,983	11	6
Lady Bertha	230	631	1	0
Bedford United	208	900	1	0
East Wh. Russell	186	779	17	6
South Bedford	157	469	0	0
Wheal Friendship	144	£848	5	0
Yarner	131	370	1	6
Wheal Emma	130	589	15	6
Kelly Bray	122	304	19	0
Gunnis Lake (Clitters)	119	666	18	0
Okel Tor	80	223	0	0
Brookwood	50	253	9	0
Gawton Copper	36	128	14	0
Fursden	34	192	19	0
Hawkmoor	30	144	15	0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.		
1	Vivian and Sons	589½	£3,282	18	6
2	Freeman and Co.	399	2,327	4	6
3	Grenfell and Sons	664½	4,163	5	0
4	Crown Copper Co.	—	——		
5	Sims, Willyams & Co.	801	4,756	4	0
6	Williams, Foster & Co.	856½	4,185	9	0
7	Mason and Elkington	507	2,330	10	9
8	Bankart and Sons	465	£2,190	1	6
9	Copper Miners' Co.	361½	1,399	5	9
10	Charles Lambert	548	1,327	5	0
11	Newton, Keates & Co.	—	——		
12	Sweetland and Co.	455	1,493	7	0
	Total	5647	£27455	11	0

Average Produce, 6½
Quantity of Fine Copper, 350 tons 10 cwt.

Average Standard £122 13 0
Average Price per ton 4 17 0

Copper Ores.

Sampled April 9, and sold at Swansea, April 29.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Berehaven	98	10½	10	£8	17	6
	83	10½	14	8	18	6
	120	10⅛	5	8	10	0
	84	10⅜	7	8	14	6
	126	11⅛	6	9	10	0
	117	10⅜	2	8	14	0
Cobre	90	10⅝	14	8	6	0
	86	10¼	6	8	5	0
	73	10½	7	8	6	6
	89	10	6	8	10	0
	83	10⅞	6	8	11	0
	74	10⅝	1	8	5	6
Knockmahon ...	69	12¼	6	11	2	0
	68	12⅛	7	10	14	6
	50	12⅜	6	10	13	0
	102	13	6	11	6	0
	80	8⅞	7	7	9	0
	100	12⅜	6	10	14	0
Ookip	63	34	6, 7	29	18	0
Ookip...............	60	33¾	3, 6	£29	16	0
	59	33¼	5	29	16	6
	25	31	3	27	17	0
Wheal Maria ...	53	24½	3	21	18	0
	38	23½	3	21	0	6
Springbok	1	9½	3	8	0	0
Ballycummisk...	37	14¼	7	12	9	0
	29	9⅝	2, 6	7	15	0
	37	4⅜	2, 6	3	7	0
Carthagena	41	8⅝	3	8	15	0
	2	38⅜	2	30	10	0
Worthing Reg..	37	58⅛	14	52	14	6
Schull Bay	20	12¼	1	10	10	0
Halvan	10	3⅜	6	2	11	0
Mines Ryl Slag.	20	13⅝	5	11	2	6
Spanish...........	5	17½	16	15	13	6
	1	17	16	14	15	0
	1	13⅞	16	10	10	0
Phœnix	1	6¼	6	4	18	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Berehaven	628	£5,578	6	6
Cobre	495	4,142	14	6
Knockmahon	469	4,846	6	0
Ookip	207	6,127	13	6
Wheal Maria	91	1,959	13	0
Springbok	1	8	0	0
Ballycummisk......................	93	809	7	0
Carthagena	43	£419	15	0
Worthing Regulus	37	1,950	16	6
Schull Bay	20	210	0	0
Halvan	10	25	10	0
Mines Royal Slag	20	222	10	0
Spanish.............................	7	103	12	6
Phœnix Ore.........................	1	4	18	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Copper Miners' Co.	94	£822	7	0
2 Freeman and Co.	152	1,253	5	0
3 Grenfell and Sons	188	3,916	13	0
4 Crown Copper Co..........	—	—		
5 Sims, Willyams & Co. ...	109	3,002	3	6
6 Vivian and Sons............	810½	8,934	5	0
7 Williams, Foster & Co....	373½	4,068	8	6
8 Mines Royal	—	—		
9 British and For. Copper Co............................	—	—		
10 Mason and Elkington ...	98	£869	15	0
11 Bankart and Sons	—	—		
12 Charles Lambert.........	—	—		
13 Ravenhead Copper Co.	—	—		
14 Sweetland, Tuttle & Co.	210	3,438	12	0
15 Bold Copper Co.	—	—		
16 Jennings and Co....	7	103	12	6
Total	2132	£26,409	3	6

Black Tin Sales.

Date.	Mines.	Tons.	c.	q.	lbs.	Price per ton £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
April 16.	West Fowey Con...	34	16	1	10	63	15	0	——	2253	18	9
„ 17.	„ ...	0	15	1	3	45	0	0	——			
„ 24.	Par Consols	60	8	2	22	63	15	0	——	3852	14	8
„ 28.	Prideaux Wood ...	2	13	3	3	63	0	0	——	177	14	3
	„ ...	0	3	2	22	45	0	0	——			
May 2.	Cornubia	2	10	1	2	68	0	0	——	170	18	2
	Drake Walls	7	2	1	5	67	7	6	——	1269	19	3
	„	12	4	2	20	64	12	6	——			
„ 3.	Basset and Grylls.	22	5	2	27	—			——	1232	14	7
„ 6.	Gurlyn	6	13	3	25	63	15	0	Chyandour	427	0	6
„ 10.	Gt. Wh. Vor	23	5	0	11	—			——	1556	8	7
	Penhalls	6	2	1	17	—			Calenick	385	11	3
	Kitty (St. Agnes) .	8	14	3	18	—			ditto	518	3	5
„ 13.	Brea Consols	3	13	1	23	69	7	6	R. R. Michell and Co.	309	10	0
	„	0	13	3	24	60	10	0	ditto			
	„	0	6	0	9	41	0	0	ditto			
„ 14.	So. Carn Brea......	4	16	1	1	60	12	6	Bissoe	634	7	11
	„	5	13	0	3	60	12	6	Carvedras			
„ 16.	Trevenen	5	13	3	7	68	10	0	Enthoven and Sons...........	432	13	1
	„	1	0	0	24	42	0	0	ditto			
	Wheal Vyvyan ...	2	11	3	24	62	10	0	ditto	180	11	0
	„ ...	0	9	0	9	40	0	0	ditto			
...age	Gt. Wh. Fortune...	23	17	0	25	—			——	1622	15	0
Quantity	Pedn-an-drea	10	15	0	23	—			——	678	15	11

Copper Ores.

Sampled April 23, and sold at Swansea May 13.

Mines.	Tons.	Produce.	Purchasers.	Price.
Cobre	101	10⅝	3	£8 15 0
	96	10½	3	8 15 0
	94	10⅝	11	8 10 6
	90	10¼	6	8 16 0
	52	20⅝	5	18 2 6
	47	20½	3, 7	17 15 0
	13	57	11	45 17 6
	102	11	6, 7	9 14 0
	92	11⅛	3	9 10 0
	100	11⅛	1, 7	9 7 0
Knockmahon ...	189	10¼	6	8 13 0
	67	12	6	10 7 0
	66	12¾	7	10 17 0
	118	12⅞	6	11 2 0
	63	14⅛	7	12 2 0
	93	13	6	11 4 0
Berehaven	128	10⅛	14	8 12 0
	81	10⅜	10	8 16 6
	100	9¾	2, 7	8 5 0
	36	9¾	3	8 5 0
	100	11⅛	2	9 10 0
	82	11	1	9 9 0
Cuba Ore.........	98	11⅞	7	9 19 6
	95	11⅞	7	9 19 6

Mines.	Tons.	Produce	Purchasers.	Price.
Cuba Ore.........	90	12	2	£10 0 0
	87	11⅞	7	10 3 0
	40	20½	3	17 11 6
	48	20⅛	6	17 9 0
	46	20⅛	6	17 8 0
Precipitate ...	5	62	5	50 14 0
Gt. Northern Mining Co. of South Aus. ...	97	17	1	14 12 6
	30	13⅝	1	11 17 0
	10	15	1	13 1 0
	9	22⅛	5	19 12 0
	6	20¾	1	17 0 6
	5	18¼	1	16 0 6
	2	36⅞	2	29 17 0
	1	29	2	22 0 0
	3	8⅝	6	7 14 0
Wheal Maria ...	57	23¼	10	20 14 6
	52	23½	12	21 7 6
Ookip	26	28¼	5	25 7 6
Llandudno	67	2	5, 6	1 1 0
	37	1¾	16	0 16 6
Mines Ryl. Reg.	21	49	5	44 6 0
	20	43¼	5	38 10 0
British Reg. ...	30	28¼	16	25 0 0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount
Cobre	787	£8,488 12 6
Knockmahon	526	5,552 12 0
Berehaven	527	4,600 10 6
Cuba..............................	518	6,460 18 0
Gt. Northern (S.A.)	163	2,368 2 0
Wheal Maria	189	£2,292 16 6
Ookip	26	659 15 0
Llandudno	104	100 17 6
Mines Royal Reg.	41	1,700 6 0
British Regulus	30	750 0 0

EACH COMPANY'S PURCHASE.

		Tons.	Amount.
1	Copper Miners' Co.	280	£3,329 6 0
2	Freeman and Co.	243	2,344 4 0
3	P. Grenfell and Sons	397½	4,173 1 0
4	Crown Copper Co.	—	——
5	Sims, Willyams & Co.	166½	3,767 12 6
6	Vivian and Sons	668½	7,057 3 6
7	Williams, Foster & Co.	583¾	6,078 9 0
8	Mines Royal	—	——
9	British and For. Copper Co.	—	——
10	Mason and Elkington	138	£1,896 3 0
11	Bankart and Sons	107	1,397 14 6
12	Charles Lambert	52	1,111 10 0
13	Ravenhead Copper Co. ...	—	——
14	Sweetland, Tuttle & Co.	128	1,100 16 0
15	Bold Copper Co.	—	——
16	Jennings and Co.	67	780 10 6
	Total	2831	£33,036 10 0

Sundry Copper Ore Sales.

Date.	Mines	Tons. c. q. lbs.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
April 8.	Greenbourne	20 12 2 23 ...	5 17 6...	Bibby, Sons, & Co. ...	185 11 11
„ 21.	„	14 2 3 14 ...	4 11 6...	ditto	
„ 15.	Alderly Edge (precipitate)...	11 3 1 0 ...	57 5 5...	Sims, Willyams & Co.	639 6 0

Blende Sales.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s d.
April 29.	Minera	42 ...	2 10 6 ...	A. Courage and Co.	307 9 0
	„	50 ...	2 10 6 ...	ditto	
	„	22 ...	1 10 6 ...	ditto	
	„	16 ...	2 12 0 ...	ditto	

Copper Ores.

Sampled April 9, and sold at Swansea, April 29.

Mines.	Tons.	Produce.	Purchasers.	Price.		
Berehaven	98	10½	10	£8	17	6
	83	10¼	14	8	18	6
	120	10¼	5	8	10	0
	84	10⅝	7	8	14	6
	126	11⅛	6	9	10	0
	117	10⅜	2	8	14	0
Cobre	90	10⅝	14	8	6	0
	86	10¼	6	8	5	0
	73	10¼	7	8	6	6
	89	10	6	8	10	0
	83	10⅜	6	8	11	0
	74	10⅝	1	8	5	6
Knockmahon ...	69	12⅞	6	11	2	0
	68	12⅛	7	10	14	6
	50	12⅝	6	10	13	0
	102	13	6	11	6	0
	80	8⅞	7	7	9	0
	100	12⅝	6	10	14	0
Ookip	63	34	6, 7	29	18	0
Ookip..............	60	33¾	3, 6	£29	16	0
	59	33¼	5	29	16	6
	25	31	3	27	17	0
Wheal Maria ...	53	24½	3	21	18	0
	38	23½	3	21	0	6
Springbok	1	9½	3	8	0	0
Ballycummisk...	37	14¾	7	12	9	0
	29	9⅝	2, 6	7	15	0
	37	4⅝	2, 6	3	7	0
Carthagena......	41	8½	3	8	15	0
	2	38⅝	2	30	10	0
Worthing Reg..	37	58⅜	14	52	14	6
Schull Bay	20	12½	1	10	10	0
Halvan............	10	3½	6	2	11	0
Mines Ryl Slag.	20	13⅛	5	11	2	6
Spanish...........	5	17½	16	15	13	6
	1	17	16	14	15	0
	1	13⅞	16	10	10	0
Phœnix	1	6¼	6	4	18	0

TOTAL PRODUCE AND VALUE.

	Tons.	Amount.		
Berehaven	628	£5,578	6	6
Cobre	495	4,142	14	6
Knockmahon	469	4,846	6	0
Ookip	207	6,127	13	6
Wheal Maria	91	1,959	13	0
Springbok	1	8	0	0
Ballycummisk......................	93	809	7	0
Carthagena	43	£419	15	0
Worthing Regulus	37	1,950	16	6
Schull Bay	20	210	0	0
Halvan	10	25	10	0
Mines Royal Slag	20	222	10	0
Spanish.............................	7	103	12	6
Phœnix Ore.........................	1	4	18	0

EACH COMPANY'S PURCHASE.

	Tons.	Amount.		
1 Copper Miners' Co.	94	£822	7	0
2 Freeman and Co.	152	1,253	5	0
3 Grenfell and Sons	188	3,916	13	0
4 Crown Copper Co..........	—	——		
5 Sims, Willyams & Co. ...	109	3,002	3	6
6 Vivian and Sons............	810½	8,934	5	0
7 Williams, Foster & Co....	373¾	4,068	8	6
8 Mines Royal	—	——		
9 British and For. Copper Co........................	—	——		
10 Mason and Elkington ...	98	£869	15	0
11 Bankart and Sons	—	——		
12 Charles Lambert.........	—	——		
13 Ravenhead Copper Co.	—	——		
14 Sweetland, Tuttle & Co.	210	3,438	12	0
15 Bold Copper Co.	—	——		
16 Jennings and Co....	7	103	12	6
Total	2132	£26,409	3	6

Black Tin Sales.

Date.	Mines.	Tons.	c.	q.	lbs.	Price per ton £	s.	d.	Purchasers.	Amount of Money. £	s.	d.
April 16.	West Fowey Con...	34	16	1	10	63	15	0	——	2253	18	9
„ 17.	„ ...	0	15	1	3	45	0	0	——			
„ 24.	Par Consols	60	8	2	22	63	15	0	——	3852	14	3
„ 28.	Prideaux Wood ...	2	13	3	3	63	0	0	——	177	14	3
	„ ...	0	3	2	22	45	0	0	——			
May 2.	Cornubia	2	10	1	2	63	0	0	——	170	18	2
	Drake Walls	7	2	1	5	67	7	6	——	1269	19	3
	„	12	4	2	20	64	12	6	——			
„ 3.	Basset and Grylls.	22	5	2	27	—			——	1232	14	7
„ 6.	Gurlyn	6	13	3	25	63	15	0	Chyandour	427	0	6
„ 10.	Gt. Wh. Vor	23	5	0	11	—			——	1556	8	7
	Penhalls	6	2	1	17	—			Calenick	385	11	3
	Kitty (St. Agnes) .	8	14	3	18	—			ditto	518	3	5
„ 13.	Brea Consols	3	13	1	23	69	7	6	R. R. Michell and Co.			
	„	0	13	3	24	60	10	0	ditto	309	10	0
	„	0	6	0	9	41	0	0	ditto			
„ 14.	So. Carn Brea	4	16	1	1	60	12	6	Bissoe	634	7	11
	„	5	13	0	3	60	12	6	Carvedras			
„ 16.	Trevenen	5	13	3	7	68	10	0	Enthoven and Sons............	432	13	1
	„	1	0	0	24	42	0	0	ditto			
	Wheal Vyvyan ...	2	11	3	24	62	10	0	ditto	180	11	0
	„ ...	0	9	0	9	40	0	0	ditto			
[illegible]	Gt. Wh. Fortune...	23	17	0	25	—			——	1622	15	0
	Pedn-an-drea	10	15	0	23	—			——	678	15	11

Copper Ores.

Sampled April 23, and sold at Swansea May 13.

Mines.	Tons.	Produce.	Purchasers.	Price.	Mines.	Tons.	Produce	Purchasers.	Price.
Cobre	101	10⅝	3	£8 15 0	Cuba Ore.........	90	12	2	£10 0 0
	96	10¼	3	8 15 0		87	11⅞	7	10 3 0
	94	10⅝	11	8 10 6		40	20¼	3	17 11 6
	90	10¼	6	8 16 0		48	20⅛	6	17 9 0
	52	20⅝	5	18 2 6		46	20⅛	6	17 8 0
	47	20⅛	3, 7	17 15 0	Precipitate ...	5	62	5	50 14 0
	13	57	11	45 17 6	Gt. Northern Mining Co. of South Aus. ...	97	17	1	14 12 6
	102	11	6, 7	9 14 0		30	13⅝	1	11 17 0
	92	11⅛	3	9 10 0		10	15	1	13 1 0
	100	11⅜	1, 7	9 7 0		9	22⅛	5	19 12 0
Knockmahon ...	189	10¼	6	8 13 0		6	20⅜	1	17 0 6
	67	12	6	10 7 0		5	18¼	1	16 0 6
	66	12¾	7	10 17 0		2	36⅛	2	29 17 0
	118	12⅞	6	11 2 0		1	29	2	22 0 0
	63	14⅛	7	12 2 0		3	8⅝	6	7 14 0
	93	13	6	11 4 0	Wheal Maria ...	57	23¼	10	20 14 6
Berehaven......	128	10⅜	14	8 12 0		52	23¾	12	21 7 6
	81	10⅝	10	8 16 6	Ookip	26	28¼	5	25 7 6
	100	9¾	2, 7	8 5 0	Llandudno	67	2	5, 6	1 1 0
	36	9¾	3	8 5 0		37	1¼	16	0 16 6
	100	11⅛	2	9 10 0	Mines Ryl. Reg.	21	49	5	44 6 0
	82	11	1	9 9 0		20	43¼	5	38 10 0
Cuba Ore.........	98	11⅞	7	9 19 6	British Reg. ...	30	28¼	16	25 0 0
	95	11⅞	7	9 19 6					

TOTAL PRODUCE AND VALUE.

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Cuba..............................	518	6,460 18 0	Mines Royal Reg.	41	1,700 6 0
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2 Freeman and Co.............	243	2,344 4 0	11 Bankart and Sons	107	1,397 14 6
3 P. Grenfell and Sons.........	397½	4,173 1 0	12 Charles Lambert	52	1,111 10 0
4 Crown Copper Co.	—	——	13 Ravenhead Copper Co. ...	—	——
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6 Vivian and Sons...............	668½	7,057 3 6	15 Bold Copper Co.	—	——
7 Williams, Foster & Co.......	583¾	6,078 9 0	16 Jennings and Co.............	67	780 10 6
8 Mines Royal	—	——			
9 British and For. Copper Co.	—	——	Total.....................	2831	£33,036 10 0

Sundry Copper Ore Sales.

Date.	Mines	Tons. c. q. lbs.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s. d.
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„ 21.	„	14 2 3 14 ...	4 11 6...	ditto	
„ 15.	Alderly Edge (precipitate)...	11 3 1 0 ...	57 5 5...	Sims, Willyams & Co.	639 6 0

Blende Sales.

Date.	Mines.	Tons.	Price per ton. £ s. d.	Purchasers.	Amount of Money. £ s d.
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	„	50 ...	2 10 6 ...	ditto	
	„	22 ...	1 10 6 ...	ditto	
	„	16 ...	2 12 0 ...	ditto	